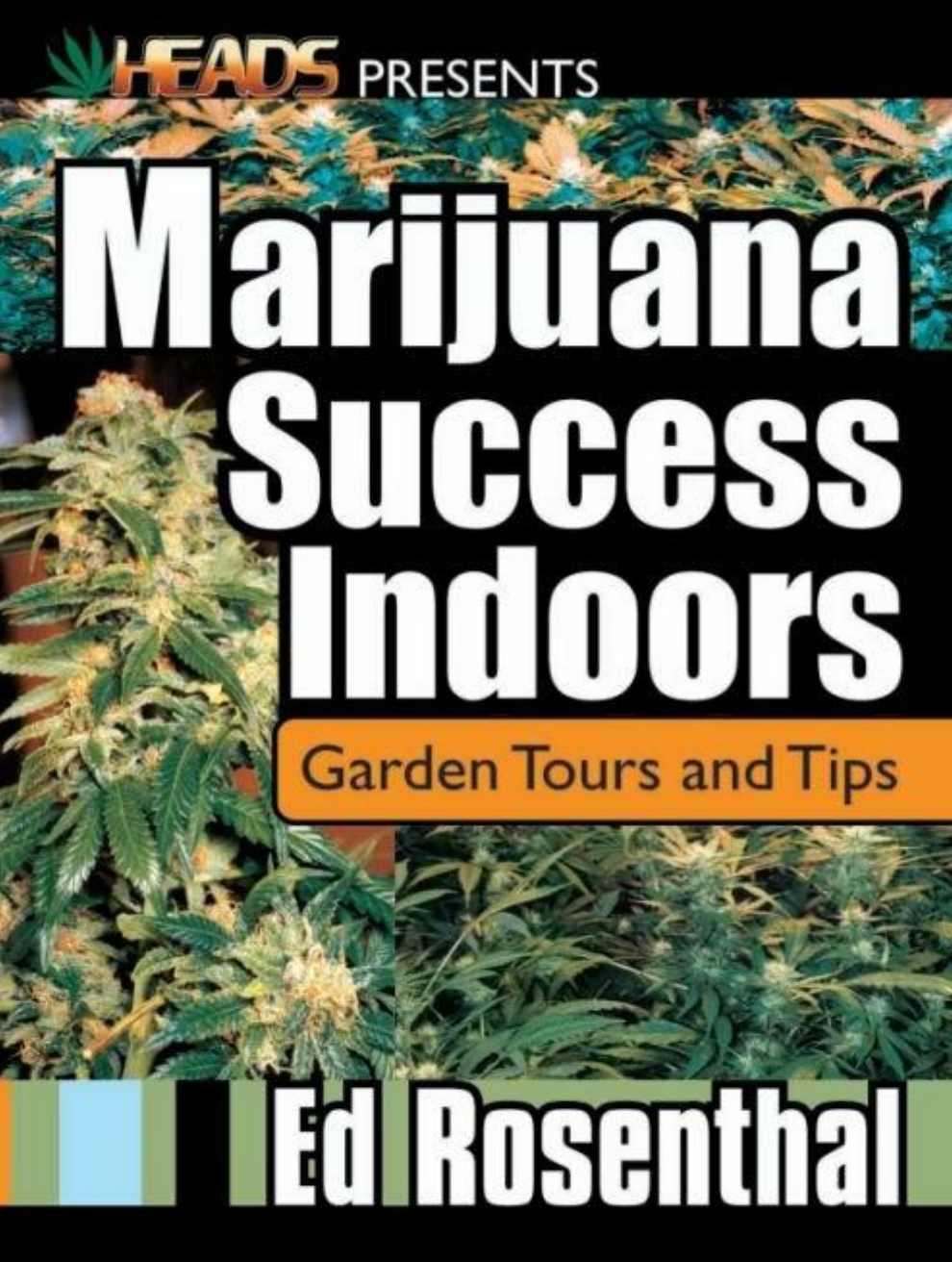




HEADS PRESENTS

Marijuana Success Indoors

Garden Tours and Tips

Ed Rosenthal

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 PRESENTS

Marijuana Success Indoors



 Ed Rosenthal

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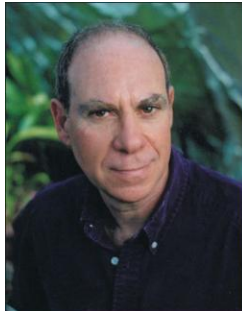
INTRODUCTION



Despite a lack of evidence in their favor, drugwar zealots often claim that using marijuana is addictive. While using marijuana may not be addictive, growing it is. There is good reason for this. Humans have always had a connection to the plant kingdom, and humans and cannabis have developed an affinity for each other. Cannabis is the only plant that produces THC, the substance that fits a brain receptor for anandimide, which is ubiquitous in vertebrates. This turn-on gives us an interest in the plant and, in turn, cannabis has thrived through the attention and assistance humans have provided.

Cannabis has a fascinating history. It was one of the first cultivated plants. It is commonly presumed that all cannabis is descended from plants that were domesticated at some point. Cannabis might have been growing “wild” in the U.S. Midwest, or in vast fields on the Russian steppes, doing fine on its own, but humans interceded somewhere in its long history, and the plant was cultivated. Unlike most cereals such as maize, rice or wheat, cannabis is so adaptable that when it travels with humans, it often tries life on its own.

Cannabis was probably first used by humans for its high-fat, high-protein seed. The seed was collected from the plant, not the ground. When the collected seed was planted, humans inadvertently selected for seed that stuck to the plant, rather than fell to the ground and the plant’s evolutionary direction was therefore altered.



At the same time the two species bonded. This symbiotic relationship preceded modern religions, national governments, our concepts of morality, and our secular understanding of the world. Cannabis and humans met under the stars of a night sky, clear and unpolluted.

Hemp seed was a nutritious, high-energy food when boiled into mush or roasted and eaten crackling. However, the big surprise came when the deseeded branches were placed on the embers to produce a flash of heat. Fragrant sweet smells filled the air and within minutes the camp sitters were intoxicated on THC. Humans and cannabis made magic together, becoming co-species. The many uses of cannabis – as food, fuel, construction material, cloth, medicine, and herbal intoxicant – as well as its adaptability to many environments made it a perfect traveling companion and helped human societies to evolve. As the only plant to produce THC, cannabis

developed a special relationship with the human species, likely the only vertebrate that craves its high.

Cannabis has no close relatives in the plant kingdom. It is classified as a single species in its own genus. Its closest relation, the hops plant, produces its own psychoactive substance, lupulin. To my knowledge, cannabis is the only true annual plant that is “dioecious”, which means it has separate male and female plants.

The unique and versatile uses of this plant have allowed the genetic pool to diversify, resulting in plants with widely varying characteristics. Different cannabis strains exhibit an impressive range of environmental preferences, morphology and production of cannabinoids.

Cannabis gardening has changed more in the last 30 years than in the 7,000 years previous, which is the amount of time cannabis has allowed humans to cultivate it. Rather than accepting traditional farming methods, or perhaps out of necessity, modern marijuana gardeners and farmers have advanced the practical technology of growing. I have been privileged to document the development of many of these new techniques. One important area of development is the focus of this book: indoor cultivation.

Gardeners moved indoors in the 1970s. Since that time, experiments and debates have been ongoing as to the best way to grow indoors. Of course the biggest factors, beyond good genetic stock, relate to “environmental controls.” These include lighting choices, temperature, humidity, fertilizing and other garden supplements that contribute to healthy plants and healthy harvests.

Gardening is an age-old art, but indoor cultivation combines green-thumb intuition with new science and technology. Indoor planting can seem very complicated. Getting information from manuals and other sources of guidance is key, but sometimes the choices involved – whether to grow hydroponically or in planting medium, what types of nutrients and fertilizers are required, what type of lighting to use – can be intimidating ones.

This collection lets you look into the gardens of real people and see how they have answered these questions. It shows exactly what happens in real life in gardens ranging from low- to high-tech. It explains gardening both hydroponically and in conventional planting mixes. In the process, it offers a hands-on view of many different types of indoor methods, as well as some simple principles and tips to help increase quality and yield in virtually any type of garden. The reason I like this project so much is because the essays are about people and their plants. The common thread is that the gardeners have a passion to produce excellent marijuana in their spaces. This book gives me an opportunity to provide you with a comprehensive look at cultivation from the gardener’s vantage point. It was a pleasure to view and report on these gardens. I hope the essays and photos transmit to you some of the excitement I felt when I was “in the field.”

Ed





Indoor Growing

This homemade tray was painted with plastic resin for waterproofing. The small room with a tray on either side was constructed in the basement. The plants were hand watered from the top. The water drained to the reservoir underneath.



Cannabis

Cannabis is an annual plant. Each spring the plant germinates and begins a period of rapid growth. As fall approaches, the plant's growth changes from vegetative to flowering or reproductive. Female and male flowers are found on separate plants. To produce seeds, pollen from male plants must fertilize the female flowers. When the male plants are removed from the garden, the females remain unfertilized. The resulting clusters of virgin flowers are called sinsemilla – Spanish for “without seeds.” These “buds” are prized by the marijuana connoisseur. Undisturbed by gardeners, the male plants will release their pollen into the air, lose vigor and die. The female plants continue to produce flowers for quite a while as long as they remain unfertilized. Once fertilized, the small ovary found behind each flower begins to swell and within a few weeks, mature seeds are produced. When most of the flowers are fertilized, the plant ceases to produce new flowers. Instead, most of its energy goes to the maturing seed. As the seeds mature, the female plant also loses vigor and dies. Varieties

There are thousand of varieties of marijuana. They have different potential yields, highs, flower sizes, bud structures, ripening times, heights, leaf shapes, colors, bushiness, and amounts of light required for adequate growth. In much the same way that environment affects the yield and flavor of grapes, it also affects the genetic potential of marijuana. The taste, quality of high, yield, and color are all subject to modification by the environment. Some of the factors include amount and quality of light, water, temperature, quantity, ratios and kinds of fertilizers or nutrients, and cultivation practices.

Breeders have been developing indoor varieties that are high-yield, potent and compact. For most gardeners, those commercial seeds or clones are the best choice. While the price of these seeds or plants may seem costly at first, getting the best seed stock is the most inexpensive way to improve a garden. No matter how good the

system and care of the plants, if they do not have the potential for massive high-quality buds, they will never produce them. A seed does not represent just a single plant but an entire genetic line. New plants can be cloned from plants or more seeds can be produced which carry this heritage. The plant's genes play the most important role in producing high-yield, potent marijuana. Seeds from mediocre bud are likely to produce more of the same poor quality bud.

Many companies advertise seeds on the Internet and in magazines.

They feature excellent varieties with many admirable characteristics. Another way of obtaining good varieties is by using clones. A clone, made from cuttings taken from a known, high-quality mother, is an exact genetic duplicate of the plant from which it is taken. They are the easiest way to start a garden because they are already selected for quality and have been sexed. Seeds produce plants that vary in quality and must be sexed.

The goal of the grower is to cultivate a garden of healthy, vigorous, fast-growing plants that will live up to their genetic potential. Indoor marijuana farms are limited spaces that should be used as efficiently as possible. To do this, the plants should be induced to flower while they are still short – saving space, time and energy.

To get the highest yield, gardeners grow many small plants rather than a few large ones. Smaller plants yield more per square foot of space, mature faster, and are easier to care for than large ones.

Imagine a garden with a few large plants: each plant takes quite a bit of time to fill the space they are allotted. If the same space were planted with many small ones, each plant would have to grow only a little to fill the canopy.

People used to think that size or age was important, but they soon found that maturity or ripeness is more crucial. As the buds on the plants ripen, their potency increases. Whether a plant has been growing for several months or a few weeks before it is forced to flower, it will have the same potency when the flowers ripen. Plants that are flowered when they are small have little chance to develop side shoots. The result is that each plant uses less vertical space and a smaller area, and can therefore be placed closer

together. When plants are forced to flower before they have grown more than ten inches tall, they use even less vertical space.

Gardeners often find it convenient to divide the growing area into several levels of shelves to double the harvest potential. Perspective

Both set-up and maintenance of a successful indoor garden require a bit of work and some hands-on experience. Rather than setting up a gigantic, sophisticated garden without experience, it is best to start off with a less ambitious project for a greater chance of success.

There is a learning curve to follow before getting your garden running at full potential. As any farmer will tell you, “Don’t count your chickens before they hatch.”

Small gardens with one or two 1000-watt lamps are easier to maintain than large ones. They take less time but, more importantly, they do not have the problems of energy consumption, ventilation and heat that large gardens do. As we will discuss later on, lights are the biggest contributors of heat to the garden. Some of this heat can be eliminated before it gets into the garden using air-cooled lights.

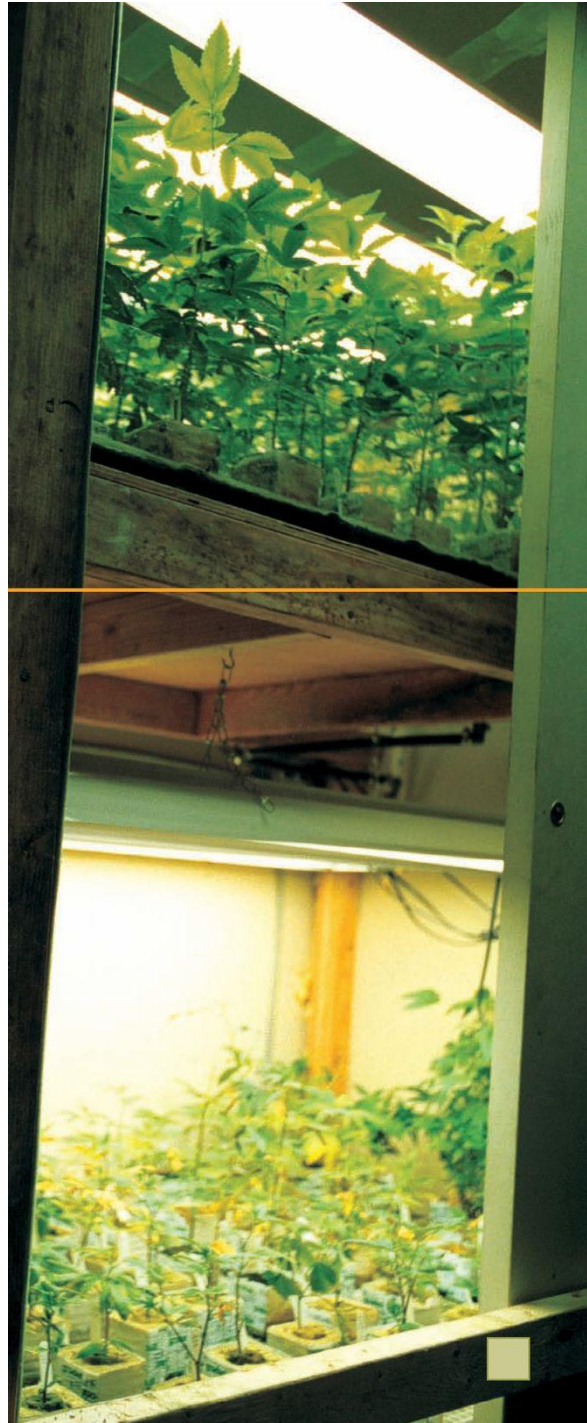
The heat created in a small system is easily dissipated into the surrounding environment, especially during the cool months. By comparison, a large operation requires a more sophisticated heat-exchange system. Lighting

Cannabis has two distinct parts to its growing cycle. First it grows vegetatively and then it goes into flowering. During the vegetative cycle, plants should receive light for a minimum of 18 hours a day, but they grow faster with continuous lighting. The vegetative cycle has several purposes. Seeds are germinated under the vegetative regimen and mother plants, which have been selected to make clones, are kept growing. Cuttings are taken from the plants periodically. The cuttings, which are turned into rooted clones, are also grown under 18-24 hours of light. Once the clones are planted they may be grown vegetatively for a week to a month, until they reach sufficient size to force flowering. The seeds, mothers and clones should be placed together in a separate space. It doesn’t need to be large since it is used mostly for maintaining a few mother plants and starting seeds and clones.

Marijuana is a short-day plant, meaning that flowering is induced when the plants receive only 12 hours of light. They measure the uninterrupted dark period using a hormone that is produced continuously but is destroyed in the presence of light. It accumulates during the dark period and

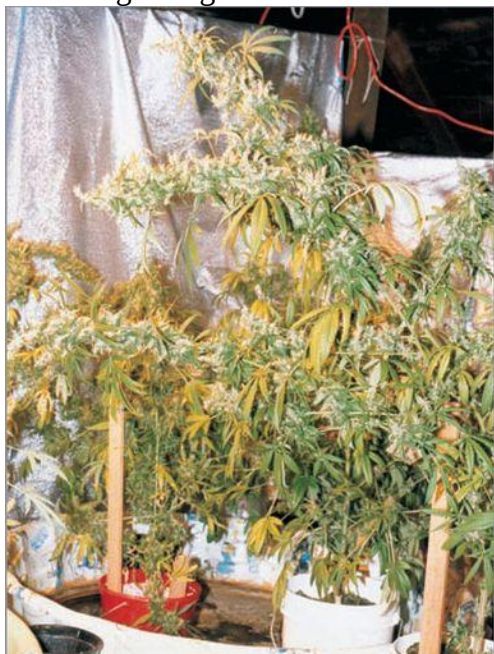
reaches a critical level at around 12 hours. When this hormone reaches a critical level several days in row, the plants change their growth from vegetative to flowering. For this reason it is important never to interrupt the dark period. The hormone is neutralized and hormone accumulation starts all over. Once the plants get to the desired size for flowering, the lights are turned down to 12 hours.

This clone room was built on two levels in a twocar garage. The small clones were placed in four-inch rockwool cubes for finishing into “starters” that were ready to grow in the flowering room.



Both set-up and maintenance of a successful indoor garden require a bit of work and some hands-on experience. Rather than setting up a gigantic, sophisticated garden without experience, it is best to start off with a less ambitious project, with a greater chance of success.

Sativa remnants of a reservoir garden in an attic. Reflective plastic was strung on rope tied to beams to create a space. Plants were grown in a mix of vermiculite, perlite and planting mix, and hydrated from the bottom by pouring in two inches of water. The planting mix absorbed it within a day. The plants were watered about every five days. This garden worked well during the fall, winter and spring, but was closed down during the summer due to heat problems. A small gas heater kept the plants cozy and warm in a high CO₂ environment. The five-foot diameter pool was lit using a single 1000-watt HPS lamp.



To produce good buds that are dense and filled with sparkling resin glands, the garden requires a minimum of 35 watts of electrical light input per square foot. The buds grow denser and more potent when the plants are supplied with an electrical input of about 65 watts/sq.ft. At a higher intensity a 1000-watt lamp lights an area of about 16 square feet. A 4' x 8' table is illuminated using two 1000-watt lamps. A 1000-watt high pressure sodium (HPS) lamp is the most efficient to use, producing the most light useable by the plant for photosynthesis. Plants use light in the blue and red spectrums to power the process. Although some store owners and books insist that metal halide (MH) lamps are best for vegetative growth because they produce a whiter light, controlled experiments have proven that plants grow faster under HPS lamps than under

MH lamps. Light fixtures and reflectors can hang from chains mounted directly on a stud, or using a molly bolt into the lathing. The lamp's height is adjusted by changing its position on the chain. It is extremely important for the light to be hung securely. Should the reflector fall, it could cause an electrical short in a wet area, which is very dangerous, even life threatening. Gardens should be equipped with a circuit breaker, which will shut off the power in case of a short or an interruption of service. Each garden space should also house a conveniently located fire extinguisher for electrical fires. The Floor

The floor of the grow room should be protected from water using heavy plastic lining, especially with a wooden floor or linoleum tile surface. If the grow room is in a basement or a room where the temperature of the floor is always cool, either the surface should be insulated or the plants should be raised off the floor. This is very important because cold floors draw heat from the containers. Plants germinate and grow considerably slower when their roots are cold. There are a number of ways of insulating including Styrofoam insulation, which comes in sheets or rolls. This material has the added advantage of being very reflective, so that any light hitting the surface will bounce back to the plants. Plywood can also be placed over a layer of insulating material.

If the grow room is in a basement or a cool room, where the temperature of the floor is always cool, either the surface should be insulated or the plants should be raised off the floor.

Reflectors

Not all reflectors are the same; some are more efficient and deliver more light to the garden than others. Horizontal reflectors deliver more light than reflectors that hold the bulb vertically. The large parabolic reflectors are often poorly designed resulting in light being directed to walls rather than the garden. Several brands have premium reflectors that have special finishes and CAD inside reflectors. The Space

Gardeners have converted all kinds of spaces to grow rooms: closets, small rooms, pantries, basements, attics and sheds. The space

must be high enough to allow the plants to grow to three feet. A space five feet high can be converted into a single garden, while a space ten feet high can be converted into a twolevel garden. The area that a space covers is calculated by multiplying the length by the width; the result is the number of square feet. The size and number of lights used is based on the total area.

When the garden is configured, aisle space should be left between the plants, so that they can be attended to easily. People have an effective reach of two to three feet, so aisles are usually 18 inches to two feet wide. A four-foot wide grow space that can be reached from either side is an ideal width.

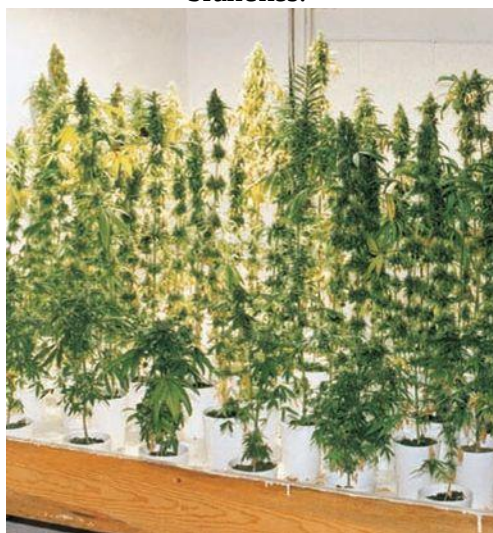
Plants can be raised off a floor using a table, wooden boards or shipping pallets. Providing air spaces that surround the plants' containers with room temperature air is crucial. Roots can also be kept warm using a heating cable or heating mat made for heating soil or containers. Some cables and mats have a built-in thermostat to keep the temperature at a constant 70°F-75°F. Heating cables and mats are available from many garden shops, are convenient to use and consume only a few watts. Water used to irrigate the plants should also be warmed to room temperature so that the roots are not shocked and cooled down. Tap water should be lukewarm and water held in a reservoir can be warmed using an aquarium heater and thermostat. CO2, Heat and Ventilation

Previously, we discussed that plants use light energy to convert airborne carbon dioxide (CO₂) and water (H₂O) into sugar. For you math heads out there, the formula is $6(\text{CO}_2) + 6(\text{H}_2\text{O}) + \text{Light} = \text{C}_6\text{H}_{12}\text{O}_6 + 3(\text{O}_2)$. The amount of light helps in determining the growth rate and yield; other factors are nutrients, adequate water, temperature and the amount of CO₂ available to the plant. In indoor gardens, ideal levels of water, nutrient availability and temperature are all easy to control. More difficult to control are factors related to the air quality – CO₂, temperature, humidity and ventilation.

This bedroom was converted into a grow space with the addition of lights and plants. The vertical parabolic reflectors are very inefficient because they are shallower than the bulb. As a result, much of the light is lost to the side walls. The plants were forced to flower when they were only eight inches tall. The indica variety grew another 4 inches and was 12 inches tall at maturity, only 10 days after this photo was taken.



These plants were grown in 32-ounce Styrofoam cups in a homemade tray. The plants were forced to flower when they were only 10 inches tall. Once they were forced they stopped growing branches.



The right wall of this space is covered with aluminum foil. The left wall is made from plywood installed to create a 2 1/2-foot by 12-foot space in the living room. The new wall was built to the ceiling so that it blocked all light as well as odor from getting to the other side. There was access to a window for ventilation. The 30 square-foot space was lit using a 400-watt metal halide and a 600-watt HPS lamp. The living room side of the wall was decorated with store-bought drapes.



These plants were pruned to four branches per plant. Each branch was staked so that it would stand upright and receive its share of the light.



CO₂ is an odorless gas, slightly heavier than air, that comprises about .035% of the air or about 350 parts per million (ppm). Plants use it as an ingredient in photosynthesis. When the plants are brightly lit and all other conditions are met, the amount of CO₂ in the air directly affects the rate of photosynthesis. Photosynthesis slows as the amount of CO₂ drops and virtually stops when the amount goes down to 200 ppm, not resuming until the amount rises again.

Conversely, under brightly lit conditions, photosynthesis speeds up as the rate of CO₂ rises. As the CO₂ in the air increases to .2% (or 2000 ppm) the plants continue to increase their growth rate and yield. The best way to regulate the supply of CO₂ to the garden is by using a small tank that holds 20 pounds of the compressed gas, controlled by a system that continuously measures the amount of CO₂ in the air and regulates a valve to keep the desired level. The plants use CO₂ only during lit hours and cannot store it, so the gas should only be on during the lit periods. It is used throughout the growing cycle in both vegetative growth and flowering.

When it comes out of the tank, CO₂ is heavier and cooler than air. The dissolved gas will evenly distribute itself into another gas, gradually dispersing from the rich air to the air with less CO₂.

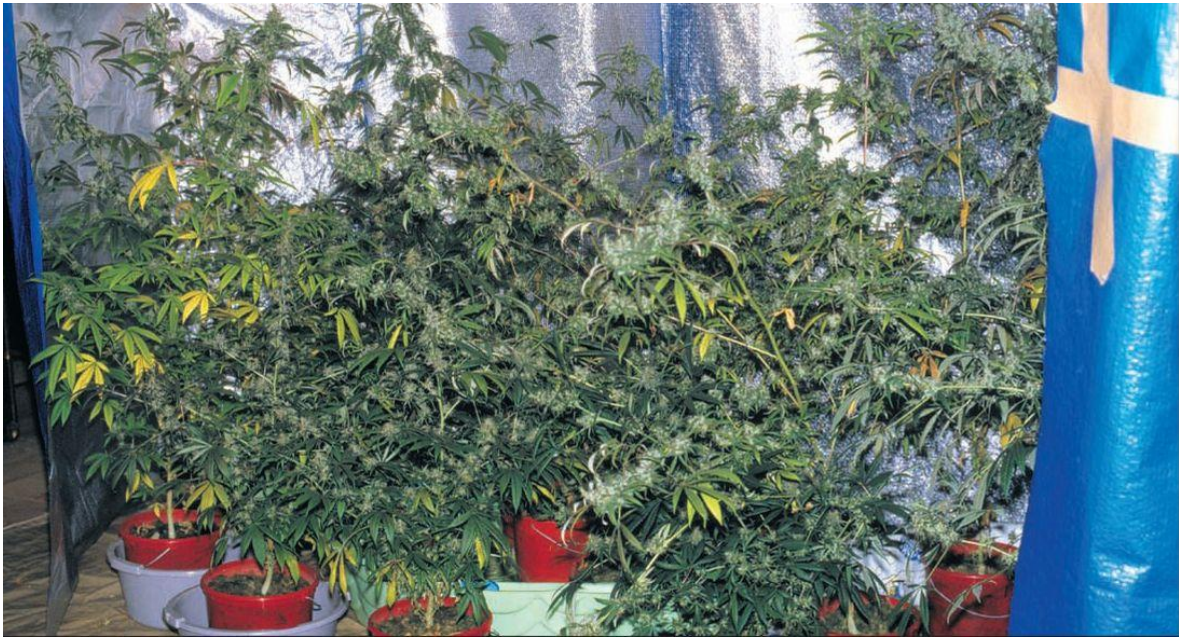
For this reason the room should be kept as tightly sealed as possible.

However, when the garden is sealed a problem results from lights heating the space, as mentioned earlier. If heat can't be removed the plants will get too hot, resulting in skimpy loose buds that never reach full potency. There are many ways to cool your space: ventilating hot air out and cool air in with fans, portable and window air conditioners, foggers, and swamp coolers in dry areas. Some of the heat problem can also be solved using air-cooled lights. The reflectors hold a pane of glass. Four-inch duct tubing is secured to a male adaptor around holes on either side of the reflector. A fan blows air into the duct from another space and the outgoing tubes vent the heated air outside the space. Up to four lights can be set up in series with fans at both ends of the system. The heated air has no odor because it has been enclosed in the tubes. It can be vented out or used to heat a cool space. This process eliminates about half the heat.

Some gardeners use powerful ventilator fans to keep their garden cooled. During warm weather they use swamp coolers in dry areas and air conditioners in humid areas. They forego the benefits of CO₂ enrichment but supply their plants with fresh air containing adequate levels of the gas. Humidity can be another problematic factor. Humidity greater than 50% is an invitation to molds and other infections. Dehumidifiers can be used to control high humidity and air conditioners also remove water from the air as it is cooled. Mini-computers are available which automatically regulate heat, temperature, humidity and CO₂. They can be programmed to turn on the dehumidifier when it gets too humid. The CO₂ stays at a set ppm of 2000 during the light periods. The window air conditioner is turned on when the space hits 80°F. The ventilator exchanges the air once an hour. The CO₂ is turned off while this is happening and then the unit is turned back on, enriching the air after the exchange is complete.

A warehouse space was enclosed with silvered plastic taped to a frame built from PVC pipe.

There was plenty of ventilation in the drafty space. Hot air rose to a 30-foot ceiling. An oscillating circulation fan (upper left) helped keep the air moving. Plants were hand watered. The trays caught excess water, which was eventually absorbed by the planting medium. A few simple improvements in the system would have produced a higher yield. The vertical metal halide light should be replaced by a conversion HPS lamp in a horizontal reflector. The plants should have been pruned and staked.



Planting Medium

The easiest way to get started is to buy a high-quality potting soil that is enriched with nutrients and use it to fill 6- to 12-inch diameter containers. The clones or seedlings will be planted in these containers where they will spend both their vegetative and flowering cycles. A high-quality growing medium will support the plants with nutrients during the vegetative cycle. Each region of the continent has its own high-quality brands. Check with a nursery or with growers who are familiar with the different brands.

A 6-inch container filled with high-quality planting medium supports a plant's growth for about ten days. A 12-inch container will support the plant for about a month – approximately the same amount of time the plant should grow vegetatively before it is forced to flower.

This garden grew on a custom built 8' x 8' table. Three-inch rockwool cubes were placed on eight-inch wide, 2 1/2-inch thick rockwool slabs. Three 1000-watt HPS lamps in horizontal reflectors on a three-arm light mover were used to light each table. Moveable light reflectors were constructed from two-inch rockwool board and one-by-twos. At first the Styrofoam was covered with Mylar, but was later uncovered to reflect more light back to the garden.



A planting medium without nutrients added will never support plant growth by itself; it needs fertilizers to provide essential nutrients. The easiest way to provide these is by using a water-soluble fertilizer. Fertilizers

Hydroponic fertilizers work well for both vegetative growth and flowering, but soluble houseplant formulas can also be used. During vegetative growth, plants in non-enriched mediums need a “growth” formula with near equal amounts of nitrogen (N), phosphorous (P), and potassium (K), as well as secondary- and micro-nutrients. All fertilizer packages list guaranteed minimum N-P-K levels, always in that order.

During flowering, the plants should be fertilized at each watering with a flowering formula fertilizer that has a higher amount of phosphorous than the other nutrients. It should also list micronutrients on the package. A safe but effective fertilizing method is to use the fertilizers at half-strength each time the plants are watered, usually about twice a week.

One way to grow organically is to use guano, kelp meal and rock dust. For the vegetative growth stage use the following for each gallon of water:

1/2 tblsp. guano with a fertilizer ratio of 10-3-1

1/2 tblsp. guano with a fertilizer ratio of 3-10-1

1 tblsp. kelp meal or concentrated kelp extract

1 tblsp. rock meal with a high potassium rating

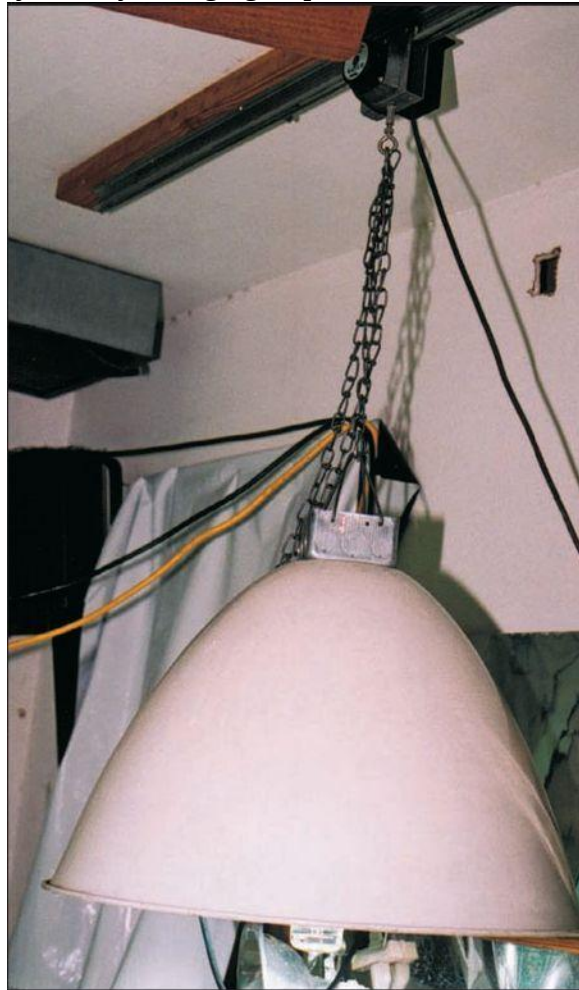
(usually about 0-0-3).

Boil water, add the ingredients and let simmer for 15 minutes. This helps dissolve the nutrients. It also creates an offensive odor. Add this concentrate to the rest of the water before irrigating the garden.

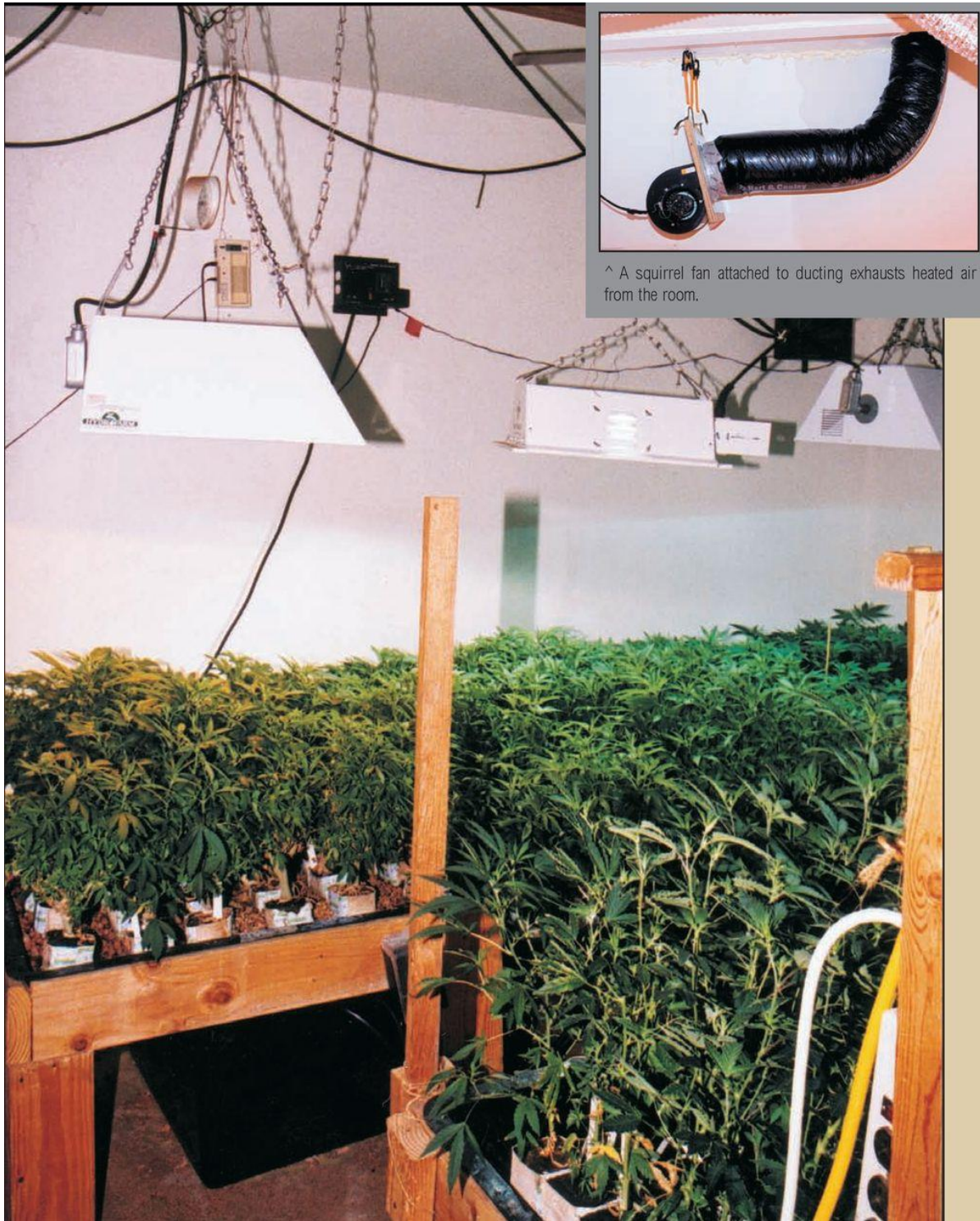
For flowering, the formula is changed to 1 tablespoon of the 3-10-1 formula. These nutrient formulas should be used once a week. They will provide the plants with a healthy mix of nutrients and minerals.

A vertical reflector hangs from a chain attached to a light mover. This vertical reflector covers

the length of the filament so that light is deflected downward to the garden rather than to the walls. The light mover travels across a six-foot track so that all portions of the garden receive intense light. A round trip on the track takes about seven minutes. The height of the lamp is easily adjusted by changing its position on the chain.



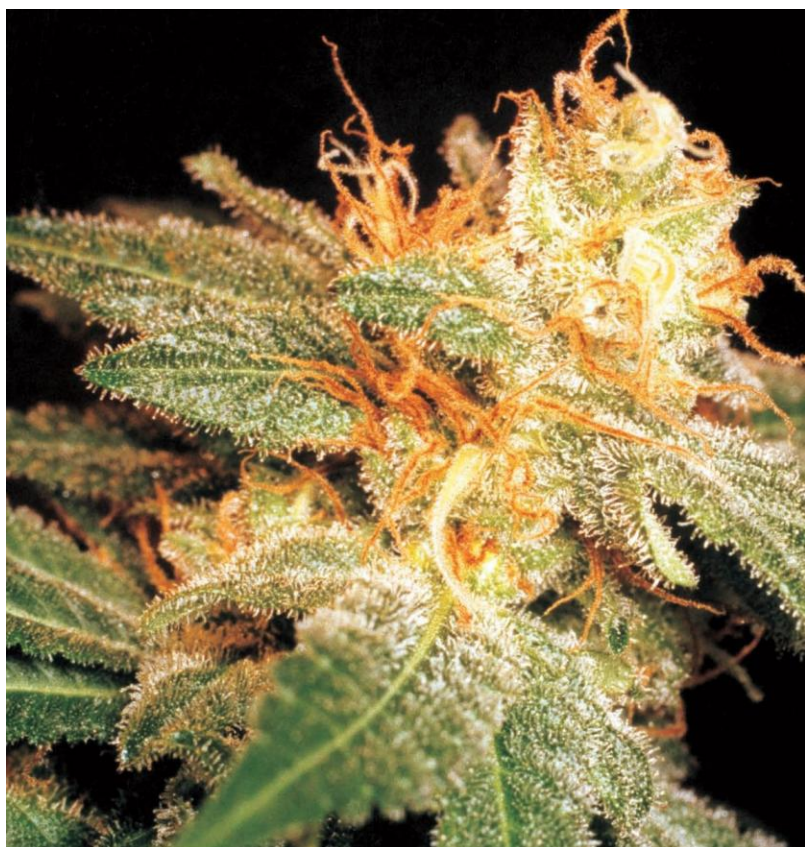
A garden using ebb-and-flow systems. The plants were grown in three-inch cubes and placed on rockwool slabs. Clay pellets were placed over the slabs to prevent algae build-up. The surface of the pellet dries out so algae will not grow. The CO₂ unit in this room is controlled by a sensor (cream-colored box over the left light), which signals the regulator (black box to the right of the left light). When the CO₂ level falls below 1600 ppm, the natural gas burner connected to the building's plumbing turns on. Burning the gas produces CO₂, water vapor and heat.



^ A squirrel fan attached to ducting exhausts heated air from the room.

You have a choice; hydro or soil. Why not take the easy way out?

Jack bud 11 1/2 weeks after forcing flowering. The glands are tightly spaced all over the flowers and small leaves. Their tips have inflated into mushroom-like crowns. The stigmas have dried and turned bright orange and receded partly into the swollen ovaries behind the stigmas. This flower is ripe.



Easy Organics



Indoor gardeners can either grow hydroponically or use a planting mix. Hydroponic gardeners use media such as rockwool, coir (coconut husk) or clay pellets, all of which are virtually nutrientfree, and then add nutrients by using water-soluble fertilizers. Planting mixes are often made up of nutrient-rich ingredients.

Each growing method has its advantages and disadvantages. Hydroponics offers easier planting, faster growth, higher yields and automated care. The advantages of hydroponics become more apparent in large systems, where handwork can be very time-consuming. In smaller gardens, where hand watering takes only a few minutes, automated systems may not save much time; however, they remove the need to be continuously available to water the plants. The other advantage of hydroponics - higher yield - is alluring for the ganja-growing hobbyist. Hydroponic gardens can be finicky but the hydroponic system is like a Porsche, when it is fine-tuned it works very well. Planting mediums are more like a Toyota sedan – very reliable. They are more forgiving because the ingredients and the microorganisms they host buffer extreme conditions. They are also generally easier to get started than hydroponic gardens. **Planting Mediums**

Planting mix gardens are the way to go for growers who do not wish to become garden experts, but would like to grow an ample harvest of good bud. They are easy to set up and do not require a large investment of time or money. If seeds are being used, each should be planted in a single 2- to 4-inch container with planting mix as described below. The seeds are planted about one-half inch below the soil line and kept moist. This can be done by placing the containers in a covered bowl or covering them with plastic wrap. The seeds usually germinate within ten days, but sometimes take only two or three days. Once germinated, the seeds should be watered every two to three days, when the soil surface begins to feel more dry than wet.

After a few weeks of growth it is time to sex the seedlings – unless you are starting with clones, which have already been sexed. Instead of sexing whole plants, which slows their growth, clip a branch from each one and mark it. The cuttings will indicate their sex by growing flowers in a week to ten days. The plant from which it came will have the same sex as the cutting.

Keep the cuttings in a jar with water and dilute water/nutrient mix. For nutrient mix, add a balanced houseplant fertilizer at one-half the recommended rate. Change the water/nutrient solution every other day. Place the cuttings under a daily regimen of 10 hours of light and 14 hours of uninterrupted darkness. The dark period is easily accomplished by moving the jar into a closet or dark cabinet each day after the plants get ten hours of light.

Within 7-10 days of forcing, the plants will begin to grow flowers, indicating their sex. Clone mothers will be the same sex as their clones. Remove and destroy the male plants – they are not moving to stage two.

Sexed seedlings and rooted clones are ready for the second stage. In this garden, 12-inch diameter containers, which hold about 2 1/2 - 3 gallons of mix, were filled with MJR planting mix, a high-quality planting medium recommended for houseplants. Other soils can be used, but should be labelled “enriched.” Generally, the more expensive mixes have better ingredients and more nutrients such as earthworm castings, compost, plant or fish meals, kelp and minerals such as rock phosphate. Enriched mixes need no fertilizers until forcing flowering, about a month after planting. Then, a high-phosphorous guano, such as 3-10-1 or 3-8-1 is added to the water at a rate of one-half tablespoon of fertilizer per gallon (5 ounces of each per 30 gallons) with each watering. The guanos are not entirely soluble, but will dissolve in water and even more so in boiling water. When the nutrients are dissolved in the solution, they reach the root zone faster so they can be absorbed more easily.

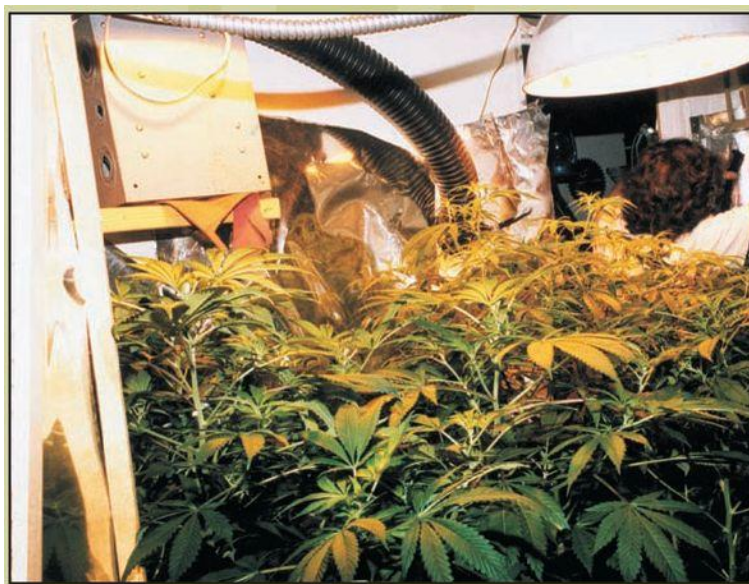
The trial garden was located in a 10' x 10' x 8' room built in a basement. The door led to an aisle flanked by 4' x 8' trays on either side. These trays were built from wood coated with epoxy for water resistance. Only one of the trays was used this time. This tray rested on several stacks of industrial pallets, about 30 inches above the floor. Rather than using coated wood trays, you will probably find it more convenient to use commercial 4' x 8' plastic trays because they don't require construction and are not likely to spring leaks.

The tray had a drainage hole on one side. To insure proper drainage, it was installed at a slant with a ratio of 1 to 40. Over the 8-foot length, there was a 2-inch slant. Twelve 12-inch standard flowerpots, which hold 3 gallons of medium, were spaced evenly on the tray. Two 400-watt lamps – a high pressure sodium and a metal halide – in old-style vertical reflectors illuminated the garden.

Thick Mylar sheets, purchased for pennies apiece at a flea market, were staple-gunned to the walls on three sides. On the fourth side, shutters (also cheap at the flea market because of broken slats) covered with Mylar could be extended for reflectivity or closed for easy access to the garden.

In smaller gardens, where hand watering takes only a few minutes, automated systems may not save much time; however, they remove the need to be continuously available to water the plants.

This garden was already growing for three weeks when the Captain staple-gunned the Mylar sheets to the wall. The garden was lit using two 1000-watt HPS lamps installed in old-style vertical reflectors.



The top of a Jack plant three weeks after forcing flowering. It has begun to grow stigmas in the last few days. The Jack can be a slowly maturing plant because its heritage, in part, is tropical sativa.



Two 20-inch window fans were hung from the ceiling at either end of the grow space. They

were on constantly to circulate the air. A 50-pound CO2 tank was opened for about 30 seconds several times a day. This occurred whenever the garden's owner, the former First Mate, now Captain, happened by when the lights were on.

The Captain was not planning to grow at all and this garden was unexpected. He tells it best: "I hadn't thought about starting this garden until a friend came over with a Christmas present of cute little clones and five bags of 'special' soil. The clones included Jack Herer, White Rhino, White Widow, Bob Marley, X-10 and Skunk #1.

"I generally discourage my friends from bringing live presents. But these rooted clones were so cute and very special, and they smelled good too, unlike a puppy, which is likely to smell poopy and entails a longer commitment. I decided to take in these 24 orphans and give them a good home for a season.

"The 24 plants seemed like a lot for such a small space, so I gave a friend 12 plants for his barelooking empty space. He had helped me with my garden in the past, and we often share herb together. I kept some Bob Marleys, the Jacks and the White Rhinos, and gave my buddy the other plants.

"The gift included several bags of soil that the giver had read about and had tried, called MJR. He said he found it to be the easiest system he had ever used. I took the clones, potted them in the soil mix and watered them. It was almost a week before they needed water again. I let the plants grow vegetatively under continuous light for six weeks, when they averaged about 18 inches tall.

"Then I pruned them and set the timer to 12 hours of light and 12 hours of darkness, and began using one cup of 3-8-1 bat guano in a 30-gallon reservoir. Each time I watered, the plants got about a half-gallon. I watered each container until water drained from it.

"Actually, although I was advised to start fertilizing at forcing flowering, I didn't start for the first 25 days of flowering. The plants were watered with this every four to six days, freeing up long weekends.

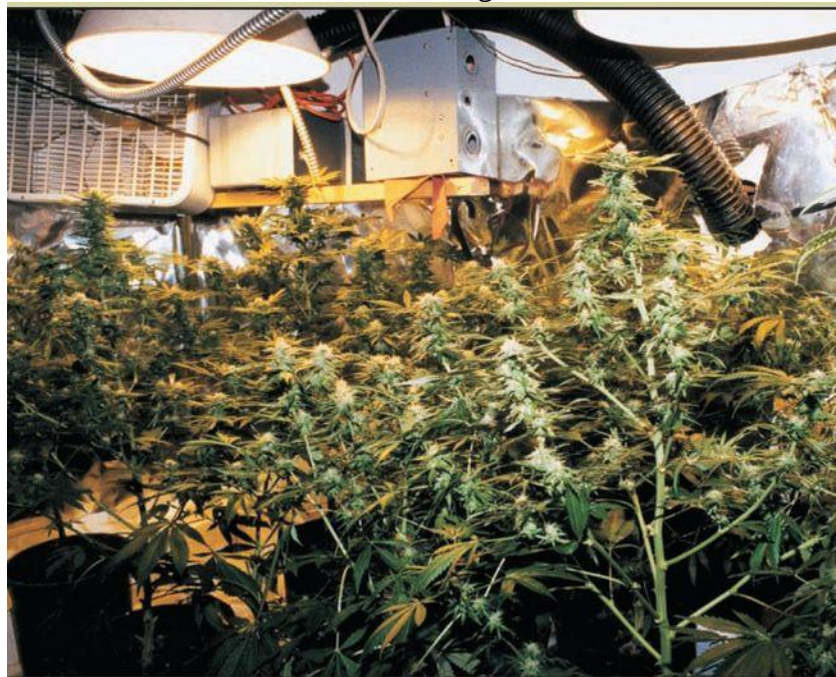
"Seventy-five days after forcing, the plants were ripe. The Jacks and White Rhinos formed tight buds ranging from medium to large. They each had excellent distinctive odors, tastes and highs; I found that I used the Jacks during the day and the White Rhinos at night. The Bob Marleys were tall, gangly plants with loose buds that never matured properly. I gave most of that pot away. The garden yielded a little less than a pound.

"After tasting the Skunks and X-10's my friend grew, I decided to try some of them in my next grow room, since they both have great flavor and highs, too."

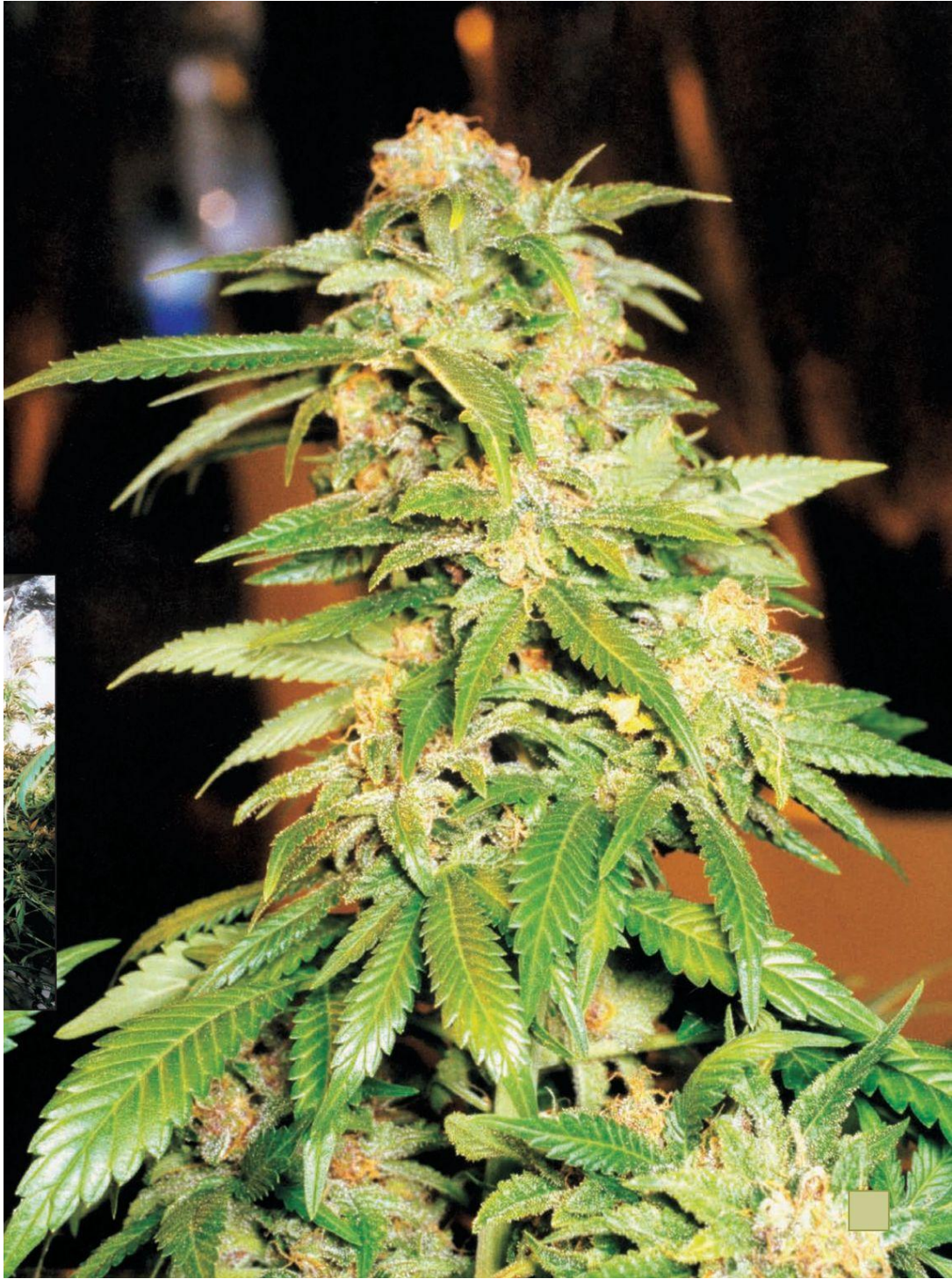
A Jack plant at eight weeks. The buds are forming along a classical open pattern on the untrimmed plant. A fan above the garden circulates the air. The ducting, attached to a fan outside the space, drew hot air from the highest corner, where it pooled. Cool air was drawn in from the frequently open door or the numerous openings in the walls.



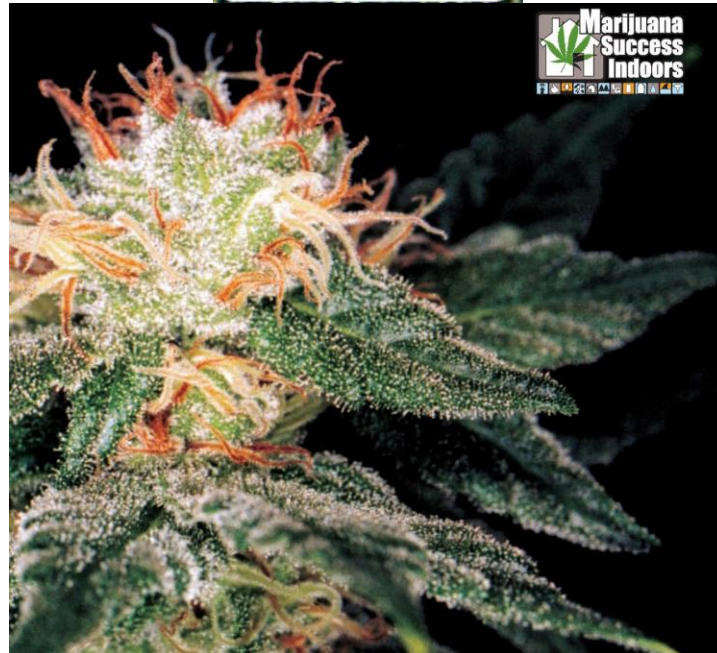
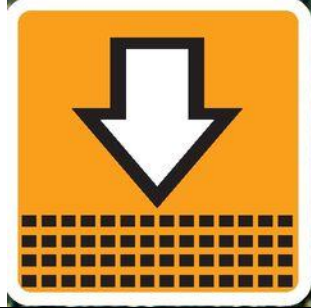
These plants were grown in 12-inch containers. They were placed on a 4' x 8' table with 5-inch sides. A moveable accordion shutter was attached to the wall with hinges. It could be moved from reflective mode when the garden was serviced. The shutter was used to keep light in the aisle side of the garden.



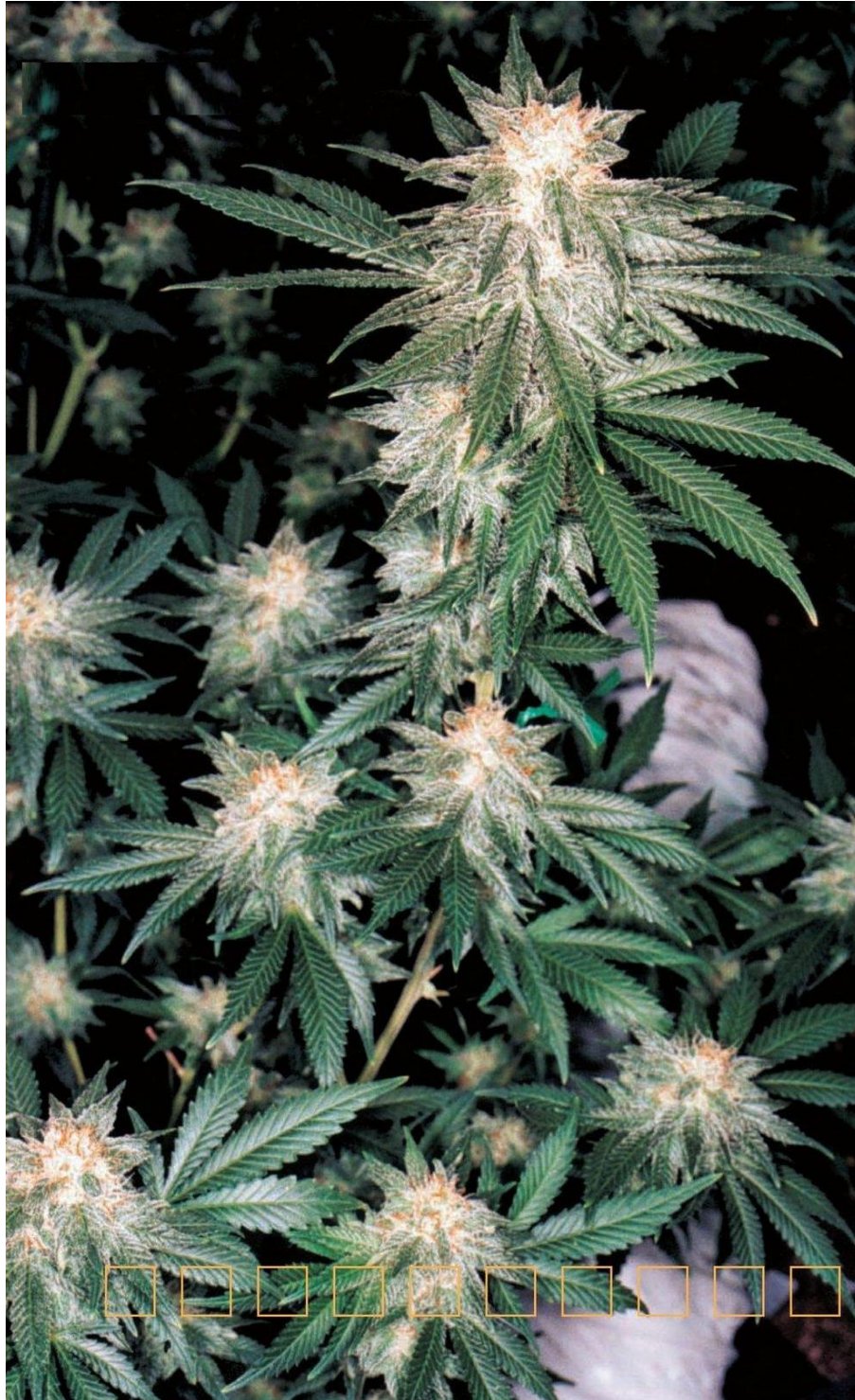
Ripe White Rhino. The dusty appearance is a layer of frosted glands covering the entire surface of the bud. The variety was cut between 10 1/2 and 11 weeks after forcing flowering.



Back 2 Soil



The plants were untrimmed, growing a large center bud and smaller buds on the lower branches



Johnny considered himself an excellent grower. He was very knowledgeable about cannabis and took his work seriously. However, after many successful harvests, he had been plagued with three crop failures.

He rew his garden using a tube system. The plants were anchored into the tube using a little cup filled with horticultural clay pellets and a rockwool cube. Every ten minutes the roots were moistened with a fine spray of nutrient/water mix. This left a shallow pl at the bottom of the

8-inch diameter tube and very humid air above the tube. Usually the plants thrived. It was only on his third 75-day crop that he faced problems. The crop failure took place in June, as the temperature rose. During the first two harvests, cool air drawn from outdoors kept the garden in the mid-70s (°F). When the temperature rose outside, the garden soared to the mid-90s, and ventilation didn't provide much cooling. Unfortunately the plants experienced this shift at the beginning of the third week of flowering. When the heat wave lifted two weeks later, the plants were worth little. **Johnny could not afford another failure. Although he had grown ten successful hydroponic crops before the two failures, he decided to try his hand using a planting medium.**

On the next crop, Johnny decided to solve the heat problem by cooling the roots. He had read some articles that recommended cooling the water to mitigate high air temperatures. He thought, "the air temperature in the room is in the low 90s, so I'll cool the roots to the low 60s." A friend offered him a water chiller he had purchased at an auction of old laboratory equipment. Several clichés come to mind regarding Johnny's decision to use this piece of equipment, like "always look a gift horse in the mouth" or "cheap is expensive." The plants started to improve as soon as the water chiller was installed. Ten days into the cooling process, the plants suddenly dried up. The leaves turned gray and shriveled. In 48 hours all the plants were dead. Johnny looked to the chiller as a probable culprit. The coils of the laboratory chiller were copper. Over the ten-day period, copper in the recirculating water system increased to toxic levels and killed the plants. Had he used an aquarium-grade chiller, the plants would probably have done well in spite of the hot air temperature.

The second crop failure was devastating to Johnny. He had pulled his first crop after seven weeks of growth. The second one was pulled after a month. He lost at least one of his four-and-a-half crops a year. He understood why all the songs about being a farmer are laments.

Johnny could not afford another failure. Although he had grown successful hydroponic crops before the two failures, he decided to try his hand using a planting medium. Knowing it was more forgiving and needing the crop, he was willing to sacrifice some yield to assure success.

I caught a glimpse of Johnny's plants when they were four weeks into flowering, with another four or five to go. They were very healthy and the buds were developing well. The cuttings, a gift from a friend, were rooted in 6-ounce Styrofoam cups punched with drainage holes and filled with vermiculite, a soil amendment available at most garden shops. Once the plants were well rooted, they were each placed in 3- and 5-gallon plastic grow bags filled with Super Soil potting mix. Ingredients listed in the mix are fir bark, pine bark, redwood sawdust, Canadian sphagnum moss, peat moss, salt-free sand, added nutrients and pH modifiers.

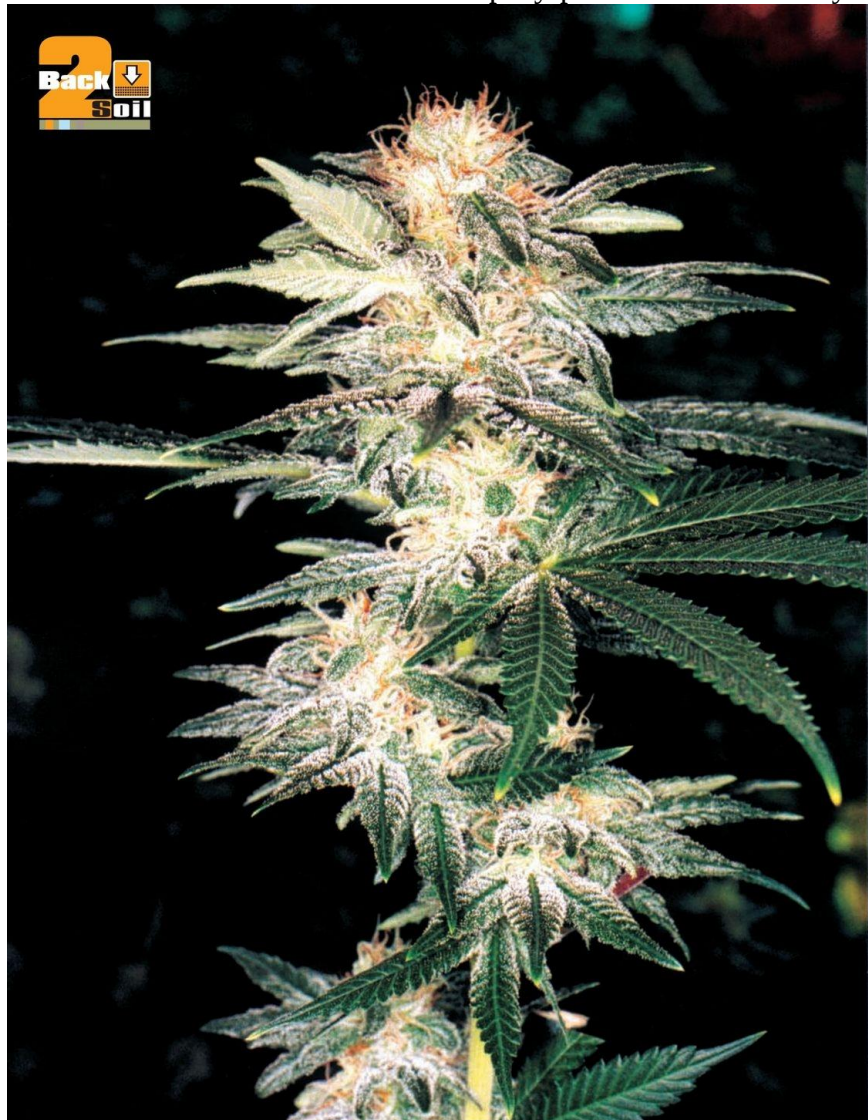
The 6' x 10' garden was lit using two 1,000-watt lamps and surrounded by Mylar-coated Styrofoam panels hung from wires. Two rail-type light movers were installed that covered the length of the garden. Each light covered a 5' x 6' area. There were a total of 86 containers. The plants were irrigated manually using a plastic watering can twice a week, which took 15-30 minutes. He used a nutrient/water solution made with General Hydro fertilizer. This brand has a three-part mix, labeled as "grow" (2-1-6), "micro" (5-0-2) and "bloom" (0-5-4). The numbers in parentheses show how much nitrogen (N), phosphorous (P) and potassium (K) the fertilizer contains and are always listed on the label in the same order. There are two reasons the fertilizers are separated this way. First, different N-P-K ratios are used at different stages of the plant's growth. The second reason is that the chemicals lock each other up if they are placed together instead of being dissolved individually in the solution.

The terms used for the three parts of the mix are in a way misnomers, as each one is supposed to be used in the solution. More of the part labeled "grow" is used during the vegetative stage

because it has the highest ratio of nitrogen. Most growers keep the “micro” part constant throughout feeding and increase the percentage of the “bloom” formula during flowering, because of its phosphorous content. The ratio of these mixtures can be changed, depending on the plant type and stage of growth.

During the 18- to 21-day vegetative stage, Johnny used three tablespoons of “grow” and one each of “micro” and “bloom” per gallon, resulting in a mix with a fertilizer ratio of 11-8-24. When the plants reached a height of about one foot, the lights were turned down to 12 hours to force flowering. Then the formula was changed to three parts “bloom” and one part each “grow” and “micro,” resulting in a 7-16-20 mix. Neither of these formulas is suggested by the manufacturer, who recommends a formula of 3 parts grow, 2 parts micro and 1 part flowering for the grow cycle and 1 part grow, 2 parts micro and 3 parts flowering for the flowering stage. Soil is a good buffer, as its organic matter locks up some of the nutrients and releases them over a period of time. This helps to prevent over-fertilization and acts as a residual source of nutrients. When I saw the plants they looked extremely healthy and dark green, and the nutrient content of the soil was very high.

The central bud looks like it has been spray-painted with white crystals.



Instead of continuing with the General Hydro formula, the nutrient solution was changed near the end of flowering to Super-Phosphate (0-20-0) to promote bigger blooms. This fertilizer supplies ample quantities of phosphorous and no other nutrients. Instead, the plants use the nutrients remaining in the planting mix. The plants obtain adequate amounts of other nutrients, but tissue concentration is reduced. Any water runoff was caught in the tray under each container.

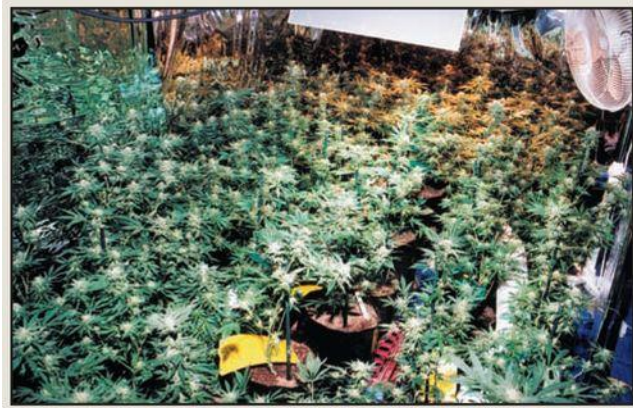
If the tray got too full, it was emptied and the water was used in the outside yard.

During the cool winter months, the garden needs just simple ventilation. With the coming of spring the temperatures rise a bit and an air conditioner is needed. Johnny is already working on the technical considerations of installing an air conditioner to exchange heat between the room and the rest of the basement.

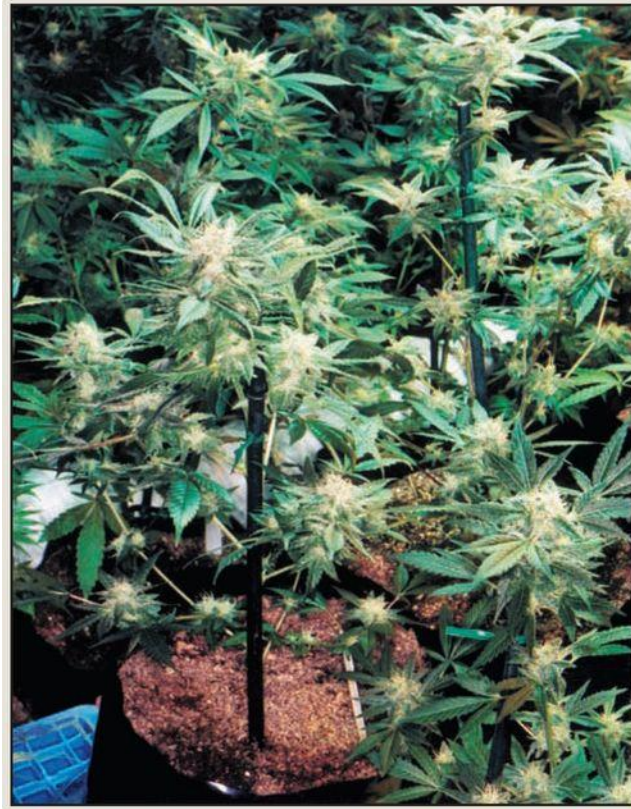
The plants' short stature, heavy budding and 70-day maturation period proved that these were obviously improved strains, meaning their genetics have been developed since the 1980s. However, their original names have been lost in transition. Two of the varieties, B-1 and Mervin, were the result of stray seeds in some excellent weed. Other varieties, including local favorites, G.C.'s Northern Lights, S.U.'s Northern Lights, Juicy Fruit, Yoshi and Washington, were gifts from fellow growers.

The garden has been very successful since the day Johnny was given a "gift" of some sickly plants suffering from a virus or bacteria. When these hydroponic plants were placed in the soil medium they recovered somewhat and produced a decent crop. That experience gave him the growing "bug," and he started his second garden with the varieties he now has, clones from better plants. He has plans for the future, too. "I'm using only half the room now. I plan to clean out the other half of the space and set that up with hydroponic tubes and CO₂, and switch the soil system to totally organic fertilizers." Meanwhile, he's waiting for his harvest, now only a month away.

These plants are four weeks from harvest. The stakes keep each plant upright. Oscillating fans circulate the air and Mylar curtains reflect the light back to the garden.



Five-gallon horticultural bags filled with high quality planting mix are then fertilized with hydro fertilizer. The result was very vigorous plants with large, healthy buds.



This 4-foot-wide garden is illuminated using 1000-watt, air-cooled horizontal lamps every four feet along the length. Each lamp illuminates an area of 16 square feet. The lights are stationary and hang about 36 inches above the canopy so that the whole area is illuminated. White polyethylene lines the walls and reflects light back to the garden. Four- by eight-foot reflective styrofoam boards (not shown in the photo) are used to reflect the light back from the aisle side. They are very easy to remove and replace. Five air-cooled reflectors are lined up in series. There are fans at both ends of the tubing, pushing and pulling the air through. The air is drawn from a hallway and vented through the ceiling to the attic where a roof fan expels it. The air-cooling removes at least half of the heat generated by the lights. The ballasts are in a separate space so they don't add any heat to the garden.

*Notice that each plant is staked and the larger plants in this mixed-variety garden are at the side so they don't block the light from the smaller plants.



5 Ways 2 A Better Garden



I know a person with a very observant eye and a keen sense of the possible. One day we were walking through a commercial area where men were unloading boxes. Errol asked to see the manager, and told him that he could improve the efficiency of the operation by 30% if he was paid \$100. The manager agreed to pay if it worked. Errol showed the manager that the men were loading only two boxes on each hand truck; he then pointed out that if the boxes were placed differently, the truck would hold four. The manager reluctantly wrote a check.

On the way out Errol said, “I can still cut unloading time by 30% for \$50.” The manager shook his head, but as we began to leave he called us back and agreed. He told the manager to increase the length of the platform on the hand trucks by attaching a board to them. The manager handed Errol a President Grant, shaking his head with an “I should have known” look.

A good look at any operation, whether it is a business or a garden, can reveal many areas of improvement. Even gardens that are maintained by experienced cultivators can usually increase their efficiency. The improvements generally result in larger, better quality yields using the same amount of energy and labor. Usually these improvements are easy to make, and most of them are based on fundamental principles. We’ll look at five factors crucial to garden improvements: genetics, lighting, staking, CO2 and heat.

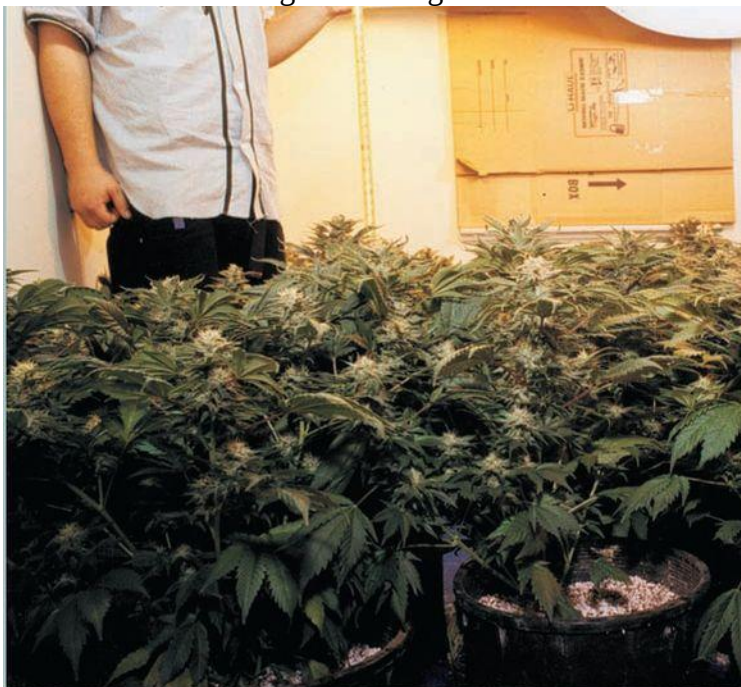
Genetics

The most important factor regarding the quality and yield of your garden is the varieties you

grow. If the plants don't have the genetic potential to produce superb bud or high yields, there is nothing you can do to help. No matter how good your techniques, you cannot improve the crop. With poor cultivation techniques, the yield and quality will suffer but the plant will still produce a certain degree of its potential. Thus the best way to improve your garden is to get better varieties.

The most important factor regarding the quality and yield of your garden is the varieties you grow. If the plants don't have the genetic potential to produce superb bud or high yields, there is nothing you can do to help.

This garden is lit using two 1000-watt HPS lamps and a single 1000-watt MH lamp connected to a rotating light mover. The vertical reflectors are very inefficient because they are shallower than the vertical drop of the lamp. Much of the light is directed horizontally from the lamp and hits the walls rather than the garden. A vertical lamp with a deeper design would reflect the light to the garden. The walls are painted white so some of the light is reflected back to the garden. The MH lamp delivers less useable light to the plants than an HPS lamp. Lowering the lights 18 inches would provide more intense light to the garden. The plants are growing in 12-inch containers with a perlite-vermiculite-worm casting mix. The garden is in the fourth week of flowering.



The main concern when choosing a variety is to make sure it is suitable for the garden. Outdoors, varieties must be acclimated to the latitude so that they will ripen before the weather changes, but not so soon that they don't grow before they start flowering. Just as there are myriad tomato varieties that have been adapted to many conditions such as cool or hot weather, wet and dry climates, and sun intensity, there are marijuana varieties with different preferences. The ability of the plant to actually produce a crop is

your foremost concern.

Indoors, you must also choose varieties appropriate to your garden. Some plants grow large and are good for gardens with large plants but will not adapt to sea of green gardens. Some plants have been bred for growing hydroponically, while other varieties perform best in a planting medium. Seed companies describe cultivation preferences of their varieties. Your clone donor should be able to give you advice about the plants s/he gives you.

After cultivation preferences, your next concern when choosing a strain is its high. If you are growing your own, you should grow the kinds you like the best. Lighting

The most efficient light to use for cultivation is the 1000-watt high pressure sodium (HPS) lamp, which emits about 140,000 lumens. This lamp produces the most light useable by the plant. No other light that supports plant growth is as efficient. Fortywatt 48-inch fluorescent lights, including cool white, warm white and 5000 K fluorescent tubes emit approximately 2000 lumens. The two main problems with fluorescents are that light production is not intense and the tubes, with an electrical input of only 40 watts are not nearly as efficient as HPS lamps. It would therefore require 25 four-foot tubes to equal the electrical input of one 1000-watt lamp. This light output is spread out so it never reaches the intensity that an HPS delivers. Metal halide lamps emit less light than HPS lamps and less of it is useable by the plants. No light other than an HPS is needed to grow plants in vegetative or flowering stages.

The light reflector also plays an important role in getting light to the garden. A well-designed reflector pushes the light down to the garden in a fairly concentrated pattern. The reflector should be placed directly over the plants so that they receive the highest intensity. Some things you can do to maximize light use:

- 1. Make sure that the garden doesn't lose light. Placing reflective material around the perimeter**

of a garden can allow yields to jump 20 percent or more. This is more important in smaller gardens where there is a greater proportion of perimeter-to-area than in larger gardens. These plants were grown in 12-inch containers that hold about 3.5 gallons of soil. Each plant has been pruned to four main branches and staked with its own bamboo pole about a week before flowering. The plants had been in vegetative stage for about a month. Two weeks after forcing flowering they were pruned again to remove any unruly growth and the new growth was tied using 4-inch twist-ties. The plants were about three feet tall. The Skunk-Haze cross took 11 1/2 weeks to mature.



2. A reflective curtain placed at the perimeter of the garden significantly increases the amount of light that gets to the garden. The curtain can be hung from the ceiling or from a frame. Moveable reflective panels can also be used. Most growers prefer Mylar or white polyethylene, but aluminum foil and silvered giftwrap also work well. Walls can be painted with aluminized greenhouse white paint or flat white paint. Perimeter panels are easily made from 4' x 8' Styrofoam paneling, which is very inexpensive and is an excellent light reflector.
3. Any light reaching the floor of the grow room is wasted. Perhaps the garden can be redesigned to receive this intense light. If not, a cardboard cone might be added to reflect the light back to the plants. The cardboard is folded and placed in the aisle, between the beds. White or painted cardboard can be used or it can be lined with Mylar, aluminum foil or white plastic. If the plant beds are close to floor level they can be lined with removable white plastic or cardboard to reflect the light. Light reflected from the cones or floor reduces stretching. Lower parts of the plant stretch as a higher ratio of infrared light, rather than red light, reaches the lower canopy. If the light can be reflected back from the floor to the plants, it is most likely to hit the lower plant sections. Its ratio of red light to infrared is high so the plants will tend to grow compactly rather than stretch.

This room has a 4' x 8' tray in the back, two 3' x 3' trays in the front and a 3' x 3' tray on the left. They are lit using 1000-watt, 600-watt and 400-watt lamps, respectively. The 1000-watt lamp hangs from a slow track mover over the 32-sq. ft. tray. Plants were shaded or lit on a five-minute rotation. Eventually, two stationary 1000-watt lamps replaced the system. The

additional light nearly doubled the yield. The on-line CO2 meter is just to the right of the thermometer. It is hooked up to the regulator to the right. The CO2 burner is partially hidden by the 1000-watt reflector. The unit is hooked up to the building's CO2 line.

Each garden uses reflectors to hold the light. A Mylar reflector can be seen at the back of the 1000-watt lamp garden. In the front garden, aluminum foil is taped to Styrofoam. The foil was eventually removed and the Styrofoam was used alone. In the left garden a Styrofoam reflector protects from light loss. The lights have been raised on their chains for garden maintenance. Normally they are kept about 18 inches from the top of the canopy.



This 20-pound CO2 tank with regulator and flow meter uses a solenoid valve to open and close. An intermittent timer regulates the valve.



Pruning and Staking

When plants are supported so that they don't shade each other, the light reaches all of them and they have space to grow. Plants need their space so that light can reach the canopy. Covered, they lose energy and growth slows. Plants can use light they receive only if all

of their needs are met. The plants in garden V were supported with an appropriate bamboo stake, but the plants in garden H were given no support, causing neighboring plants to flop over onto one another, thus shading the canopies and lowering growth rate and yield.

The problem can be solved in many ways. A sturdy bamboo stake can be used to keep the plant's central stem erect or several of the side buds can be staked. Twist-ties hold the buds to the branches. A small cage, such as a tomato cage, can be placed around each plant. Netting can be run along the length of each tube, with the stems attached by twist-ties. Plants could also be tied to rows of strings hung from the ceiling or overhead rods.

Buds on plants that are hidden by large fan leaves will not grow as quickly as buds getting direct light. Fan leaves blocking light from the buds should be removed. Leaves not blocking buds should be left on the plant. They create more sugars used for growth. CO₂

The addition of a CO₂ source can spark a dramatic yield increase in well-lit gardens. The reason is that CO₂ is one of the ingredients used for photosynthesis. Light powers a complex reaction in which hydrogen (H) and oxygen (O) from water (H₂O) are combined with carbon dioxide (CO₂) to form sugar and oxygen. The formula is $6(\text{CO}_2) + 6(\text{H}_2\text{O}) + \text{light} = \text{C}_6\text{H}_{12}\text{O}_6 + 3(\text{O}_2)$. No light other than an HPS is needed to grow plants in vegetative or flowering stages.

The ambient level of CO₂ in the air is about 400 parts per million. In a closed environment under bright light, the plants quickly lower the CO₂ level. When levels of CO₂ drop to 200 ppm, photosynthesis stops. Contrarily, plant growth increases in direct ratio to the increase in CO₂ levels. Indoors, with bright lights, plants can use 1000 to 1500 ppm CO₂. This is most easily supplied using a CO₂ tank and regulator. Some of these regulators are timer-based, others work in conjunction with the ventilation; the most sophisticated models measure the amount of CO₂ in the air. Plants grow much faster, with heavier yield, in CO₂-enriched air. Temperature

Marijuana grows fastest and yields heaviest when it grows within a moderate temperature range of 70°F-80°F during the light period and 10 degrees lower during the dark period. Gardens

enriched with CO₂ tolerate a temperature range about 5°F warmer.

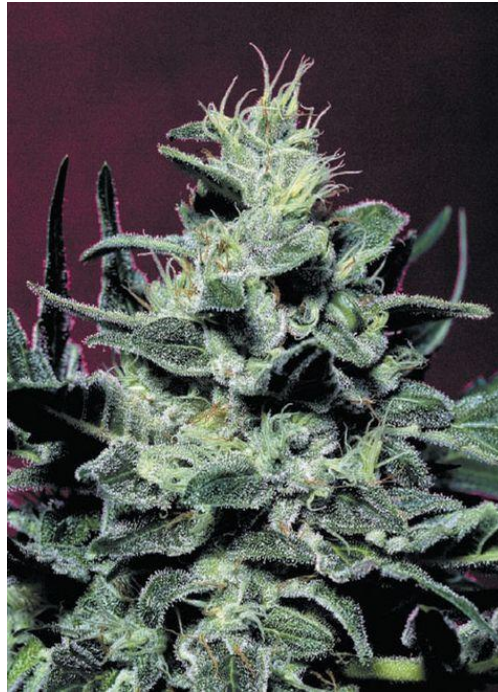
Plants in the vegetative stage stretch under warm conditions so that the distance between the leaves on the stem increases. This makes the plants taller and ganglier. During flowering, plants in conditions too hot for their comfort grow loose, airy buds that have hardly any weight. Hot conditions during the second to fifth week are the most damaging. Even if the warm conditions have been corrected halfway through flowering, the buds will not put on weight.

Light period temperatures lower than 70°F slow growth because plant metabolism decreases. At lower temperatures the plant cells function at a slower rate. Tissue building is one of the functions affected, resulting in smaller buds with lower yield. Also, many infections, including powdery mildew, thrive in the 60°F-70°F range.

There are many ways to control temperature and keep it in the ideal range. These include ventilation, air-cooled lights, air-conditioning and swamp coolers. Using these systems with automatic controls allows the garden to be maintained at an ideal temperature range, encouraging large, tight buds.

With just a few modifications you can fine-tune your garden so that it consistently produces the finest buds with a high yield.

Nebula



Soma A+



Homegrown Harvest



This garden consisted of 8-inch plastic tubes that held 3 1/2 inch mesh cups filled with horticultural clay pellets. The tubes were spaced about 1 1/2 inches apart. The cups were spaced on one-foot centers. As a result, each plant could fill an area of 12" x 9 1/2", a little more than three-quarters of a square foot. The walls dividing the sections were made from 8 mm black polyethylene film stretched on a frame made from two-by-fours. Mylar was taped to the plastic for its high reflectivity. The lamps were horizontally mounted 1000-watt HPS lamps on chains. Normally the lights were kept 24 inches from the plant tops, but they were raised on their chains for harvesting. They were spaced about 5 feet apart and each illuminated about 25 square feet of space. The plants in this garden would have benefited from staking.



Johnny is no joker. His first garden was a technological marvel. The result was a very controlled high intensity grow area. Despite two tightly sealed doors, no windows and a sophisticated air-cleaning system, two officers testified that they were able to smell Johnny's immature plants. The judge who decided the case exemplified the problem with American justice: role reversal. He forgot that he had left his job as a prosecutor. He also encouraged the prosecutor to practice playing judge.

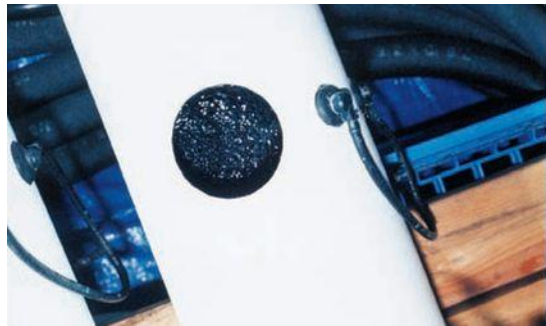
While serving six months and waiting another three years for his probation to end, Johnny designed and redesigned a new system. Finally it was time for him to set up. A friend offered him a load of grow tubes, and after renting loft space in an abandoned factory, he began to organize

his new farm. Rather than growing in one large section, he framed three large rooms and then used 6mm black polyethylene plastic to frame his space.

He covered the tops of the rooms to prevent light pollution and to contain the CO₂. The low ceiling caused heat problems later because the heated air could not escape. The spaces were in an area with 18- to 24-foot ceilings. If the ceiling had been left open, the hot air would have risen.

By enclosing the tops, he was holding the hot air in. As soon as he placed holes in the black plastic, a strong stream of warm air flowed out of the top of the garden, creating a draft and pulling in cool air from elsewhere in the structure. However, the temperature continued to climb into the high 80s (°F), heating the water in the irrigation units.

Sprayers on either side irrigated each cup. These constantly bathed the roots in a thin film of oxygenated water. The redundancy was a protection against emitter clogging. Once the water streamed down the roots it formed a thin pool as it slowly flowed to the end of the tube and drained back into the reservoir.



The reservoir: Water is pumped to the tubes through five 1-inch pipes. They distributed the water to half-inch tubing, which had been attached to the grow-tubes using plastic banding. The emitters were attached to the half-inch tubing and water flowed constantly.

The water was filtered as it returned to the reservoir for particles and smaller matter, then it trickled through an activated carbon filter (white and black devices inside right of reservoir). On the way to the plants, the water flowed through an aquarium UV C sterilization unit (white tube to the right of the reservoir). These units are commonly sold for aquariums and other niche uses. The water flows in a thin stream along a fluorescent tube that produces UV C light. This spectrum is deadly to most organisms and is considered germicidal.



The roots trailed down the tube, bathed in the highly oxygenated water/ nutrient solution. This healthy root system, which is stained by the nutrients and additives, has grown more than a foot

long. Most of it trails down the tube floor.



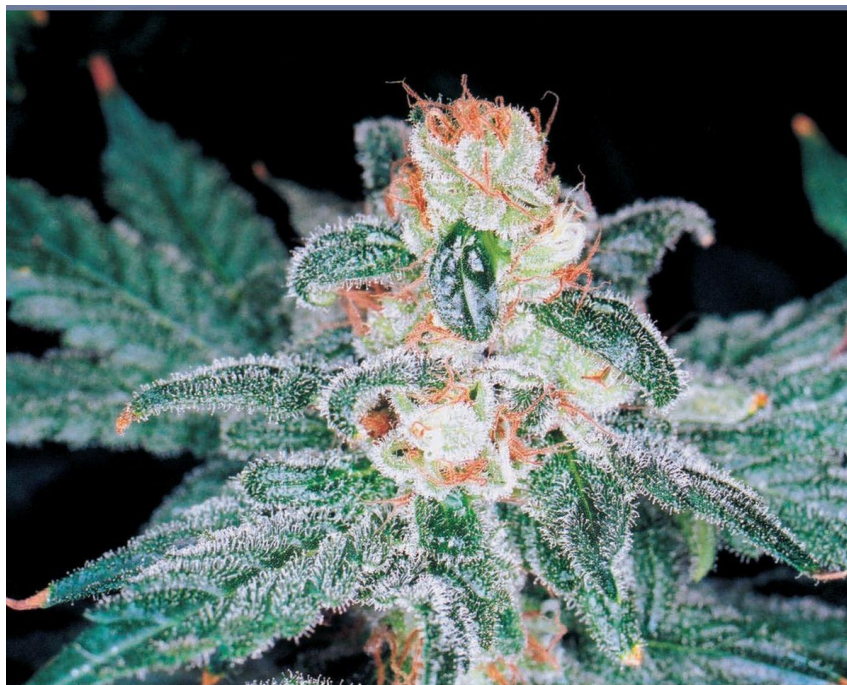
The garden used General Hydroponics tubes adapted to a continuous top-feed drip. As the water circulated, it picked up heat. As it heated up, it held less oxygen in solution. Roots need oxygen to stay healthy; lack of oxygen is referred to as an anaerobic condition. The result was unhealthy roots that were being attacked by anaerobic bacteria. They had a slight ammonia odor and the plants had a hard time surviving.

Johnny considered supplementing the water with oxygen using hydrogen peroxide, but decided instead to cool the water using an in-line water cooler. In a previous garden, he had attempted to cool the planting medium by hooking up a water-chiller with copper pipes - like the ones found in water fountains - to the water circulation system. This resulted in a bad case of copper poisoning for the entire garden. This time he installed a unit designed for keeping fish tanks cool, in which the water passes through stainless-steel coils.

General Hydroponics fertilizers, used in this system, consist of a three-part formula, which has different proportions of nitrogen (N), phosphorous (P), potassium (K) and micronutrients. Each grower has his/her own formula for using these nutrients, and several are listed on the label.

During flowering, Johnny used General

This Northern Lights hybrid was perfectly ripe. The glands were so thick that they outlined the bud's edge. The range of greens and reds pastelled by the layer of white crystalline frost makes this one of the most beautiful varieties.



Johnny experimented with ways of keeping clones fresh for extended periods, so they would be available as needed. He found that by lowering nutrient and light levels, the plants could be placed in a sort of suspended animation.

A Skunk hybrid ready to harvest for the post-season smoke-offs. Just by looking at it you know that this variety is complex and especially potent.



The plants were hung by their stems using twist ties.



This stem was left hanging in the harvested garden. Within two days the debris will be removed from the garden and it will be thoroughly cleaned, and the tubes readied for new clones.



Hydro's ABC mixture in a 1-2-3 ratio at 1900-2000 parts per million, as measured on his electrical conductivity (EC) meter.

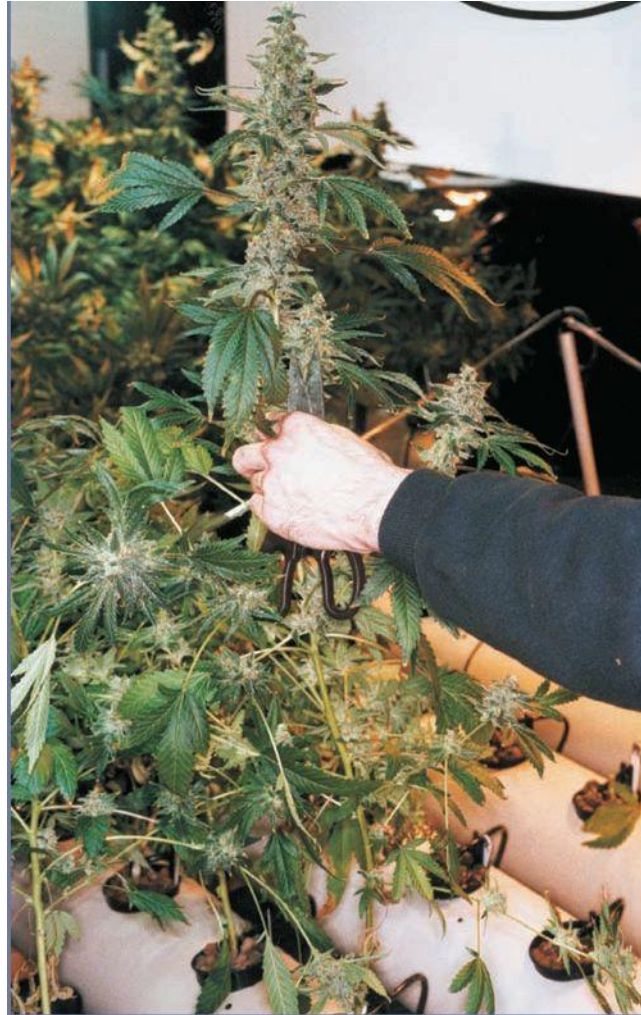
Electrical conductivity is a rough measure of the concentration of dissolved salts in the water. A conductivity level of 1,500 ppm indicates that 1,500 parts per million of the water solution are composed of dissolved salts. This takes into consideration both the fertilizer that has been added and the dissolved solids present in the tap water. EC is not a direct measurement of the salts; rather, it detects how well the water conducts electricity. The more salts, the better the conductivity. However, the electrical charges of fertilizer ingredients vary, so the concentration of salts is not absolutely proportional to the water's conductivity.

Most farmers are very conservative about trying new techniques and with good reason. Even if the yield or quality of your crop isn't great, you may be left with no crop yield at all if you try something different and it fails. But Johnny was so unhappy with General Hydroponics fertilizers that he decided to change brands after this crop. He was never able to get the plants to look totally healthy. No matter how he adjusted the ratios, there were signs of slight deficiencies. Now he uses the Genesis four-part formula.

In Johnny's geographical area, tap water contains between 50 and 150 ppm of dissolved solids.

This includes enough calcium for the water to maintain stable alkalinity, but is not so high that it affects the fertilizing program. In a previous garden in another city, he had to deal with up to 400 ppm of dissolved solids, so he installed a water purifier because the high level of minerals in the tap water affected the way the plants used the nutrients.

The plant has had its day in court. The judgment: Ripe. Cut her down, and hang her upside down by her stem until she dries out or is cut up. There were no appeals as the harvest continued inexorably down the row of grow tubes.



The last fan leaf on the branch is about to glide to the floor.



Johnny experimented with ways of keeping clones fresh for extended periods, so they would be available as needed. He found that by lowering nutrient and light levels, the plants could be placed in a sort of suspended animation. They are alive and photosynthesizing, but at such a slow rate that growth is hardly noticeable. They start rapid growth as soon as the environment has a high-light, high-nutrient level. When the clones were transplanted into the growing tubes, they were given continuous light for about 20 days. During this time they grew vigorously and reached about 15 inches in height. Then they were forced to flower. While the plants were still wet, the smaller leaves were clipped from the buds and then the buds were clipped from the stems. This manicurist preferred using a pair of small-bladed scissors.



Johnny has tried many varieties in his garden. There were ten different ones growing in his last

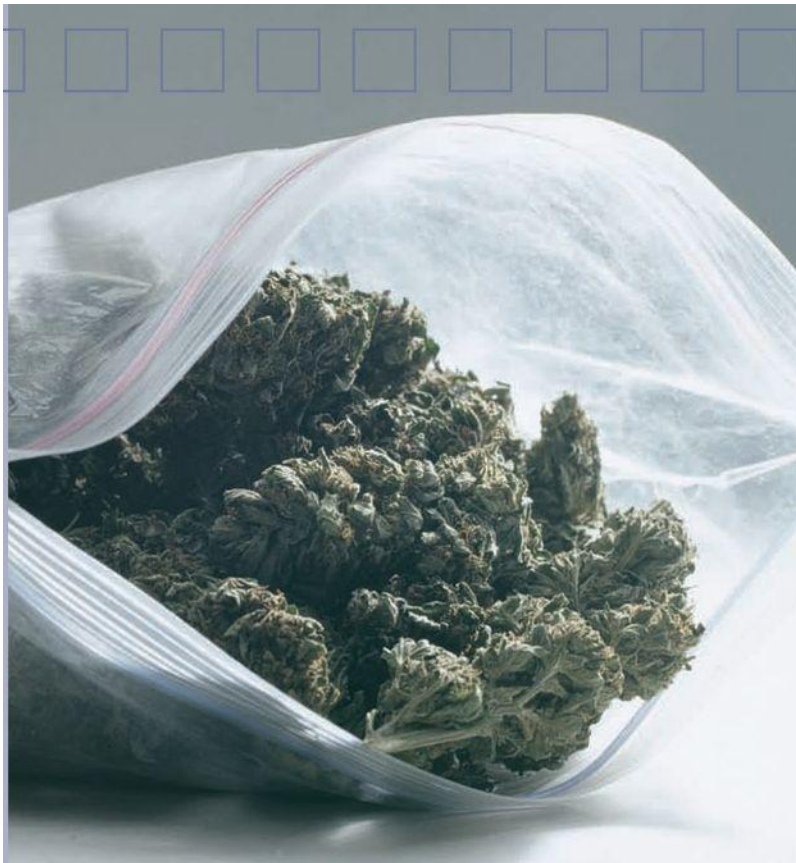
garden, but he plans to eliminate some old ones and try some new ones. The next garden will have only three or four varieties, all descended from Dutch seed companies' stock, that will produce tight, potent buds.

The plants were ready when the stigmas turned brown and receded into the ovary behind the flower as if it had been fertilized. You could see the glands swelling with THC. Normally, a garden is not harvested until almost everything is ripe and at peak, 65-80 days after forcing flowering, depending on variety. Johnny harvested after 8 weeks. Most of the plants were ripe.

But a few varieties could have used another week.

The plants were clipped, making sure all the labels stayed with the proper strains. They were then hung on strings. Newspaper was placed underneath and a team of paid manicurist friends clipped the plants, removing both the large leaves and the smaller leaves surrounding the buds. They were left under dim light in a large dry area, with a nice draft. They were dry and ready to be smoked in a week.

Photo: Kamara Inc.



Friends were invited over for a trimming party. The plants were trimmed as they hung on stretched wires. At this stage all the large fan leaves were removed, exposing the smaller leaves and buds. As the leaves were clipped they dropped onto a tarp on the floor.

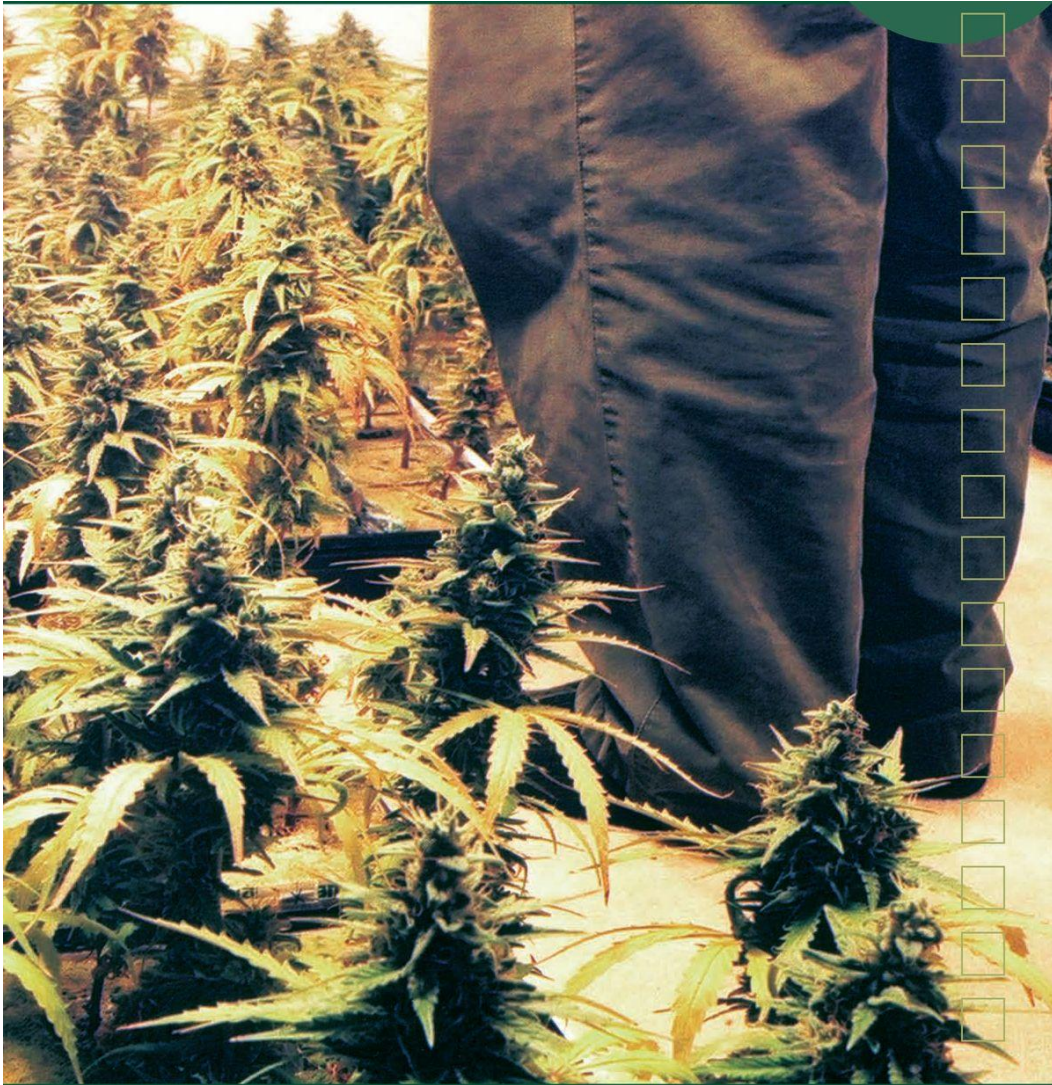


They were left under dim light in a large dry area, with a nice draft. They were dry and ready to be smoked in a week.

Miniature Forest



Giant in the forest: These plants were fully ripe but were less than a foot tall. Indicas were forced to flower as soon as the roots showed through the four-inch cubes. They stopped growing vegetatively and changed their growth to the flowering mode. Less than seven weeks later they were forced to flower.



Xena is a clone dealer who buys and sells to large growers and stores. As a result of one successful deal, she was left with 400 unsold just-rooted clones. Rather than let these healthy clones go to waste, Xena decided to bud them.

She found four 1000-watt high pressure sodium lights that had been abandoned by a former roommate. She installed them on a light timer set for 12 hours on and 12 off, forcing the plantlets into flowering. An oscillating table fan and an oscillating floor fan placed on one side of the room provided air circulation and a constant breeze. Excessive heat was vented out into the hallway, where the pungent odor particles met a couple of negative-ion generators and were neutralized.

Xena's growing system was exceedingly simple. She placed the clones, which were growing in four-inch rockwool cubes, into 10-inch x 20-inch non-draining nursery trays. She doubled up the trays to give them more strength. Ten cubes fit in each tray, in two rows of five. The 37 trays held a total of 370 clones.

The clones were watered manually once a day using a standard watering can. The nutrient solution was a local take-off on General Hydroponics' three-part formula. The formula is composed of three different mixes, labeled "grow," "micro," and "bloom." Growers change the ratios of these three parts, depending on the plants' stage of growth. As Xena was putting her plants directly into bloom, she wanted a formula that was high in phosphorus (P) and low in

nitrogen (N). For five weeks, she used a ratio of one part each “grow” and “micro” to three parts “bloom.” She kept the water/nutrient solution at a reading of 1200 ppm (parts per million) of dissolved solids. In the sixth week, the plants were irrigated only with water in order to leach the cubes. They were harvested at the beginning of the seventh week, only 45 days after forcing. The plantlets were fast-maturing Afghanis with a very strong odor and traditional heavy Afghani high. Buds averaged five grams each, and the garden yielded about four pounds of these high quality nuggets. The 75 square-foot space yielded about 24 grams per square foot. The dried shade and trim leaves were rubbed on a 100-line mesh screen. The resulting kif was pressed and produced a 40-gram block of the finest black hash.

What could Xena have done to increase the yield? She could have placed reflective material around the open side of the garden and used the same heavy white polyethylene she used on the wall.

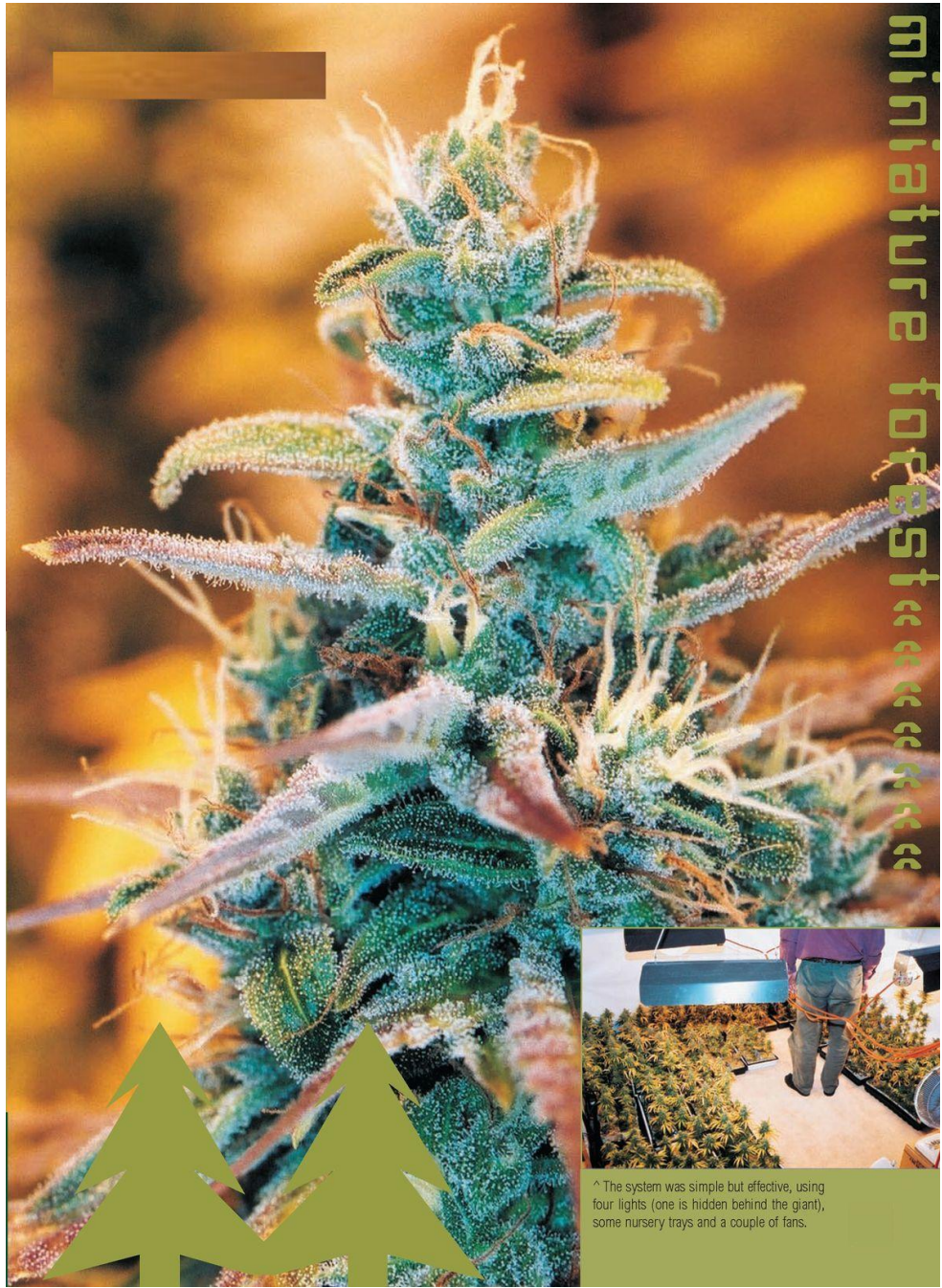
As the door of the room was kept open much of the time, there was no shortage of carbon dioxide (CO₂). It was replenished as the plants used it. However, the air could have been enriched with CO₂ by using a tank with a regulator. Tubes to release the gas could have been placed just above the plants. Growth rate and yield would have increased. The plants would have matured a few days earlier and would have been 20-30% larger.

This low-tech hydro garden was high-yielding, but was simple and took little effort. It shows just how easy Sea of Green techniques can be. Xena’s garden proves how successful a gardener can be using just a little ingenuity.

The plantlets flowered in the four-inch rockwool cubes. They were watered daily with water/nutrient mix using a watering can.



Mature indica bud ready for harvesting: The plants yielded about a pound per light.



miniature forest

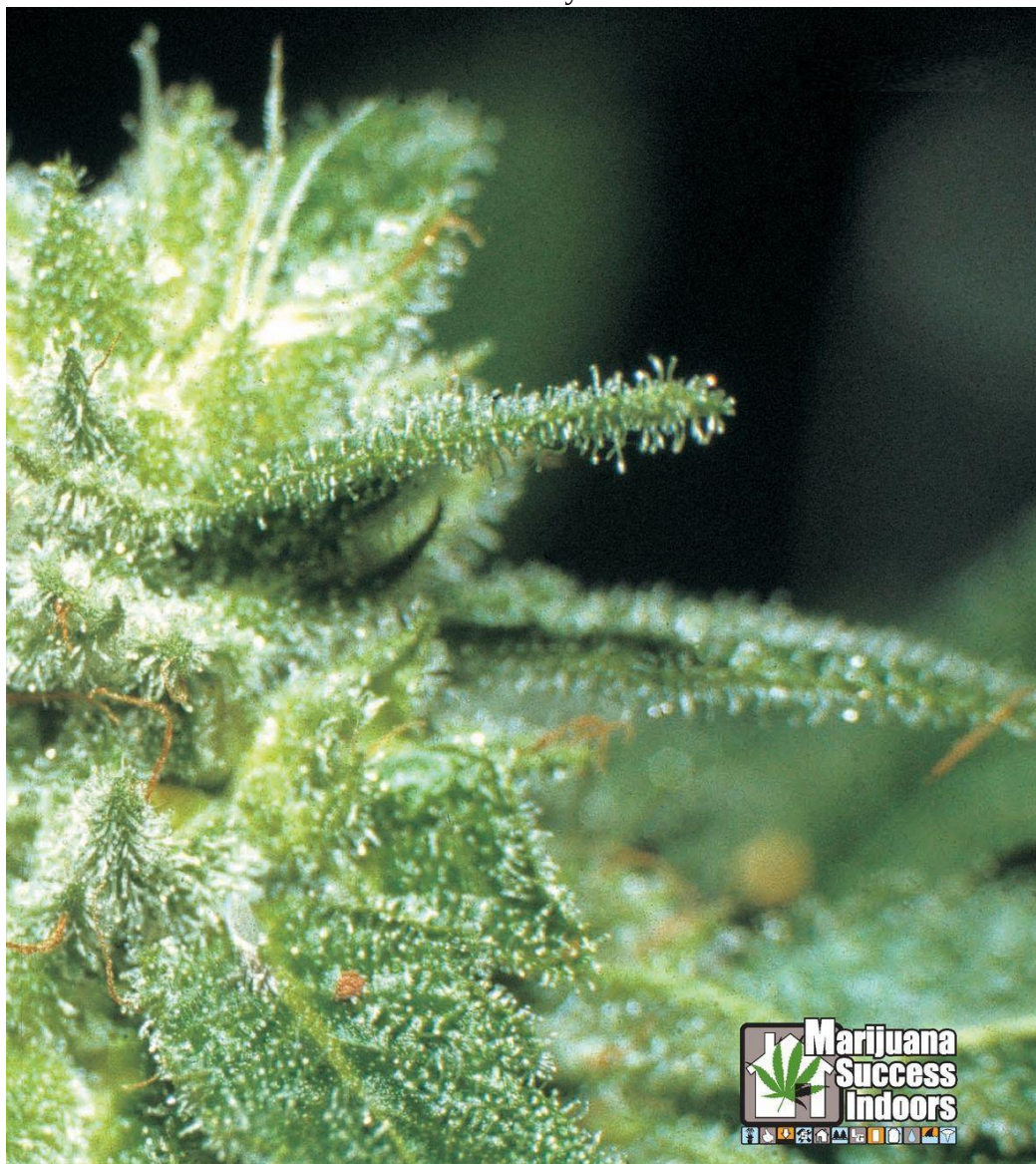


^ The system was simple but effective, using four lights (one is hidden behind the giant), some nursery trays and a couple of fans.

Liz's Garden



This bud is ready to be cut.



Liz started a garden to keep herself supplied with primo buds. She wanted an efficient lowmaintenance system that would produce high quality buds without much effort. She didn't have a lot of space to spare, so she emptied a closet and prepared it for a garden. She painted the

4' x 4' x 7' closet with flat white bathroom paint containing a fungicide. Then she laid a heavy plastic tarp on the floor to prevent water spillage.

She hung a 400-watt high pressure sodium (HPS) lamp from the ceiling with a chain so its height was adjustable. With pliers she closed one end of a large S-hook around the chain attached to each end of the light. The other end of the S-hook was also attached to the chain so that it was easy to move as the plants grew.

A 20-pound CO₂ tank and short interval timer were placed in the chamber. A hole was made in the wall to vent an exhaust fan connected to a thermostat-humidistat. This was set to turn on the fan when the temperature rose to 75°F and the humidity rose to 60 percent. An oscillating fan kept the air circulating in the room at all times.

Liz told me that it took her less than three hours to prepare the space once she removed the debris. "In fact, I took most of the stuff to my friend's garage sale and paid for the lamp and tarp from the proceeds. My total cost for the light was about \$300, the tarp was about \$6. The CO₂ unit, consisting of a tank, pressure regulator, flow meter, solenoid switch and short cycle timer cost about \$500. For \$800, what I was paying for two ounces of grass, I was ready to become independent.

"Now it was time to start the seeds. I bought some small rockwool cubes at a local indoor garden shop, placed them in a tray and watered them with a dilute solution of hydroponic vegetative growth stage fertilizer. Then I drained the tray so only a 1/4 inch of water remained.

"I poked a seed 3/8 of an inch into each cube and pushed in a plastic stake. I placed a piece of plastic wrap around the tray to keep the cubes moist so the germinating seeds would find it comfy. The seeds were direct descendants of several varieties of Dutch seed. They all had some skunk in them but were hybrids. They germinated in a few days and were ready for transplanting nine days later.

"I transplanted the seeds into round 6-inch diameter containers filled with a mixture of 5-parts pebble-sized crushed lava rock and 1-part vermiculite. The vermiculite breaks up, and sort of coats the craggy surfaces of the lava, and helps it absorb moisture."

The rock absorbs water and transports it, through capillary action, much as a tissue moves water.

As the roots draw water from the rocks, more is transported upwards. The rocks stay moist without any human effort. To make the mixture, moisten the vermiculite in the bag so there is no dust. It contains a small amount of asbestos so be careful. Using gloves to protect your skin from the lava's rough surfaces, mix the lava and vermiculite in a basin.

Liz continued, "I placed six containers in each 2' x 2' x 5"-high tray and positioned an aerator attached to tubing to the bottom of each of the five trays. Each aerator was attached to a gang valve that was connected to a medium capacity aquarium air pump." Aerators will float if they are not secured to the bottom of the tray so remember, before setting up, to attach the aerator to the bottom of the tray using silicon glue.

"To start, I watered the containers from the top with a full-strength vegetative growth-stage nutrient/water solution from Genesis. I filled each tray with two to three inches of nutrient/water solution for the lava to draw up, much like a wick. When the water level dropped, I simply added tap water.

Cuttings were placed in water and held in place with a sheet of foam plastic. The water was kept at 72°F using a small aquarium heater.



“After two weeks, I drained the trays and ran unfertilized water through the containers. It was easy to do and not messy at all. In the bathtub I used the flexible showerhead to rinse the lava with 75°F water. Rinsing the containers with plain water washes away mineral salts from the fertilizer, which have crystallized on the lava rocks. It also removes plant residues, as well as natural hormones and enzymes that have built up in the water.

“After the containers were rinsed and drained I placed them back in the trays and watered them from the top with a fresh nutrient/ water solution. When the water started to drain, which happened almost immediately, I filled the trays two inches deep with the same solution.”

Liz finally had a chance to set up the CO₂ unit. The unit was the simplest kind controlled by a repeating timer. Every fifteen minutes it injected a burst of CO₂ into the room, which she calculated would bring the amount in the space from 200 parts per million (ppm) to 1200 ppm. The total area of the space (height x width x length) multiplied by .01 equals the amount of gas required to increase the ppm to 1200. Her space, 144 cubic feet (4' x 4' x 9') multiplied by .01, required 1.44 cubic feet of gas. The regulator was set to release gas at the rate of 1 cubic foot per second so she set her repeating timer to 1 1/2 seconds every 15 minutes.

Liz changed the fertilizer solution in the trays two weeks after starting. She kept the light about 18 inches above the plants and maintained the water level in the trays at about two inches. During the month, she was away from the garden for a three- or four-day stretch. “The water level in the trays had dropped a bit when I returned, but the plants were still healthy and doing fine. As soon as I got home I added water.” Liz was a good caretaker – the plants were growing quickly, looked vigorous and showed no signs of deficiencies.

“I couldn’t believe it. In 30 days the plants had grown from seedlings to 18-inch plants. This is the size I expected them to be but it is just so amazing to watch them grow. They started out slowly but at the end they were growing more than an inch a day. The books recommended that I switch the light back after 30 days so I did this right on schedule. Since marijuana doesn’t use CO₂ at night I plugged the CO₂ timer into the light timer so that the unit wouldn’t release CO₂ when the lights were off. I also rinsed the pots out as I did a few weeks ago. However, this time I collected the water from the trays and put it in a big bucket.

“The most inconvenient chore is emptying the water from the trays. I scoop some of it out using a flat vase, then I pick up the tray and pour the water into a household cleaning bucket. Friends tell me to get a small water pump, but I haven’t gotten around to it yet. After I dumped the fertilizer water down the drain the first time, my ecological friend Jenny told me that I was polluting the water table with nutrients, which encourage algae blooms and other problems. So now I used it for my houseplants and to fertilize plants in my backyard. Re-use is the first part of recycling. Besides, my other plants have really perked up since I started watering them with the collected

water diluted 50-50 with plain water.”
The clone center was placed on a bookshelf.



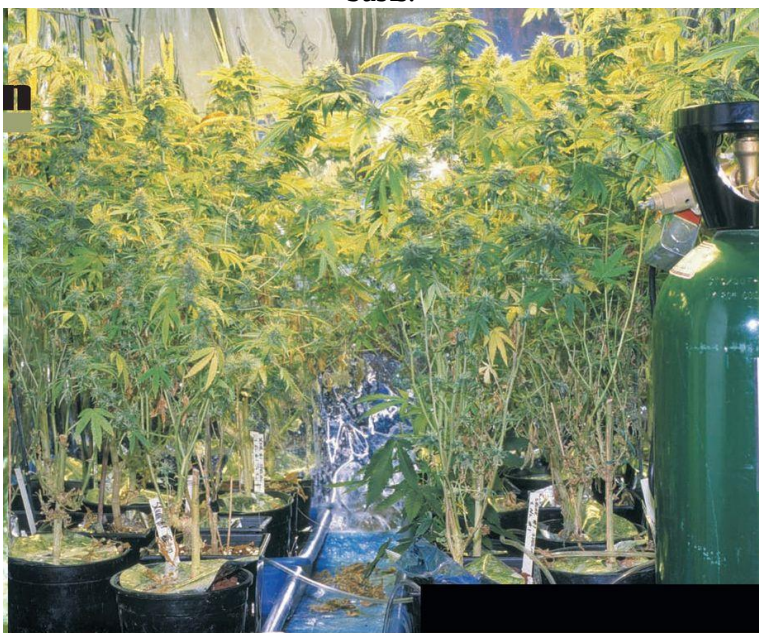
The first crop: Seedlings are planted in pea-sized lava in 6-inch containers. They are placed in 1 1/2' x 1 1/2' trays.



The trays are kept filled with three inches of water/nutrient solution. An air pump and aerator keep the water circulating and oxygenated. Plant roots grow into the water.



Trays with maturing indica-sativa hybrids. A CO2 unit injects the gas into air on a periodic basis.



Liz's garden was in mid-flower. The buds were swelling and creating their characteristic definition. The Early Pearl and Northern Lights buds grew along main branches, developing their configurations, and then swelling out. The Skunks were maturing more slowly, their buds growing large on the primary branches. The plants continued to look healthy and had stopped all vegetative growth but were still growing fast and vigorously. All of their efforts were now concentrated on the flowers. The system continued to work without a hitch. Liz added water to the trays as needed to keep a level of about

two inches. The fertilizer solution was also changed in each tray every two weeks.

Liz changed over to a flowering fertilizer when she turned the lights down to 12 hours. Flowering formulas supply less nitrogen (N) than vegetative growth mixtures. Instead, the phosphorous (P) and potassium (K) levels are increased to promote more flower growth. Still, the plants showed no signs of lacking nitrogen.

Liz led a busy life in the city. Aside from a heavy work schedule, friends and classes were keeping her busy. This created scheduling problems in the garden. She was unable to take cuttings from the plants until two weeks after turning the lights down. Her life was so hectic at the time that once she took the cuttings she didn't have time to work on them. So she placed them in the refrigerator for a few days until she had a bit of free time. **The buds were swelling and creating their characteristic definition. The Early Pearl and Northern Lights buds grew along main branches, developing their configurations, and then swelling out. The Skunks were maturing more slowly, their buds growing large on the primary branches.**

From the bottom up, her cloning kit consisted of a small heating mat (sold in nurseries) over the wooden bookshelf; a plastic tray about three inches deep, filled with water; an aerator sitting at the bottom of the tray hooked to a pump; and an almost flat Styrofoam plate salvaged from a fruit carton. The plastic tray had melted into the mat a little, so it was replaced with a glass tray.

The clones were cut from the bottom of the plants and trimmed them to about 2 1/2 to 3 inches, leaving only a few leaves at the top. She punched holes into a piece of Styrofoam and inserted the cuttings. The Styrofoam held the clones in place. The water/nutrient solution contained Olivia's Rooting Solution and flowerfertilizer at 1/4-strength. The heating mat kept the water in the tray in the low to mid-70s(°F). The aerator ensured adequate supplies of oxygen to the stems. The flowering fertilizer was used to limit leaf growth and help stimulate root growth.

Another crop growing indicas in the front and indica-sativa hybrids in the rear. This garden was forced to flower when the plants were only 10 inches tall.



Ninety days after Liz transplanted the seedlings to 6-inch pots, half the garden had been harvested. The Early Pearls and some of the Northern Lights had blossomed, ripened and been cut. Only the Northern Light hybrids, Skunks and hash plant were left. The hash plant had a hard time flowering. It probably would have done better with a longer dark period. A regimen of 13 hours darkness and 11 hours light might have solved its ambivalence about flowering.

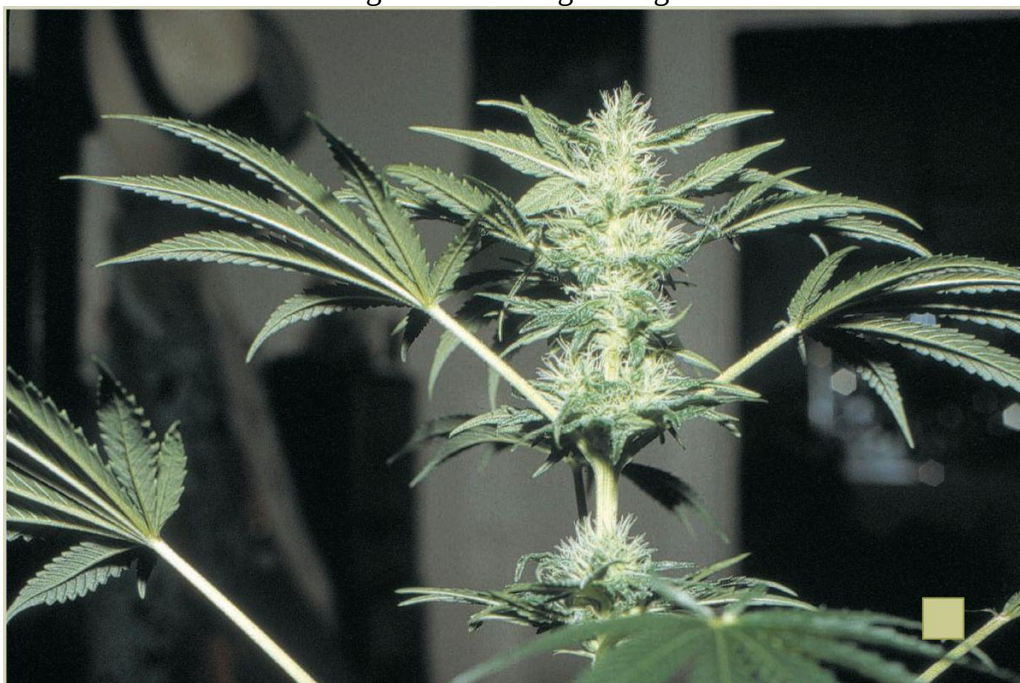
New pistil growth had stopped weeks ago. The fan leaves were yellowing and dying, leaving the maturing buds naked. The glands on the remaining plants were filled with resin. When the light was on, the buds sparkled with the twinkle dust of the fluorescing glands. The garden looked bejewelled.

This was Liz's first time out and she grew a garden of succulent, smelly, sticky, high-potency buds. The tray-and-pot system had worked extremely well. She said, "I didn't believe that it could be this easy to grow. It was kind of exciting watching the plants grow and mature but seeing these buds - it's incredible."

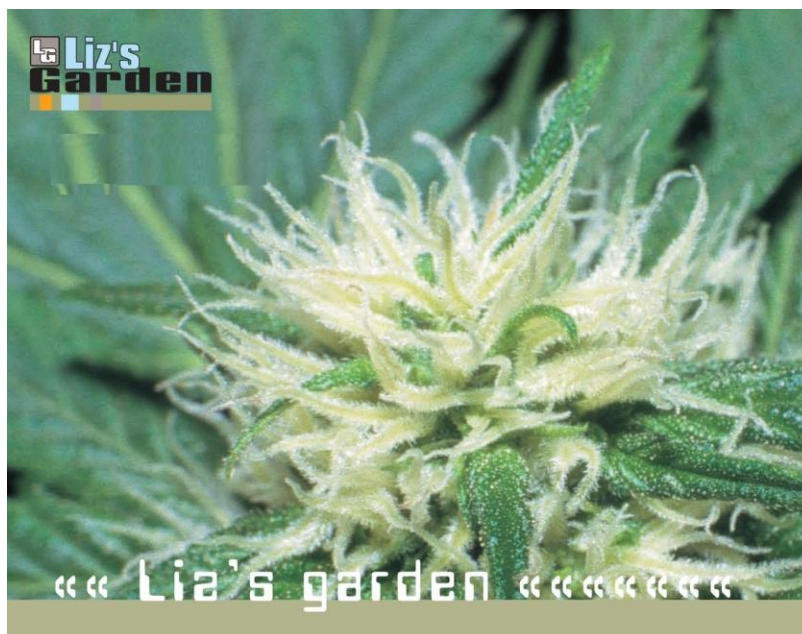
Then she recited the basic steps to her simple reservoir garden. "Put the rocks in the trays three-quarters full, place the rooted clone or seedling in, fill the container with the lava rocks.

Place the container in a five- to six-inch deep tray. Fill the tray two inches deep with nutrient/water mix using hydroponic grow formula fertilizer. Change the water every two weeks and add plain water as needed to keep the level at two inches. It's so easy."

Young bud shows vigorous growth.



Fresh stigmas of the female flower search the air for pollen. Pollenless, the plant continues to produce new flowers, forming dense colas.



The five-parts-lava-one-part-vermiculite mix stays moist through capillary action, but has large airspaces so the roots always have enough oxygen. The water itself is aerated with a small fish-tank air pump. Roots have been growing out of the containers into the water trays. They look healthy and white.

The clones, which were started two weeks after Liz forced flowering by cutting the constant light to a cycle of 12 on and 12 off, had reverted back to vegetative growth under continuous fluorescent light. They were rooted and ready to be transplanted into the garden. They have been growing slowly in a tray filled with diluted nutrient/water solution. At first Liz used a plant mat placed under the tray to keep the water at 75°F. She didn't think the mat was doing a great job, so she used a fish tank heater with a built-in thermostat instead.

Liz has harvested all of the plants in the garden, yielding between 6 and 8 ounces. She liked most of the plants especially the NL-Skunk crosses. Shortly after the first harvest Liz renovated her garden. This time she created three growing areas. Her largest space was the 4' x 4' flower room. She raised this garden up a bit and built a small vegetative growth space that could handle either clones or plants less than 8 inches tall. It was lit using fluorescent lights. This space was not intended for constant use.

The clones taken early in flowering and kept in the weak nutrient solution under lights were potted and placed in the flowering space. They were kept under constant light but took only three weeks to reach ten inches. This was Liz's second crop. She decided to save some of her favorite plants using regeneration. First, the buds were picked from the plants, and only leaves were left on a stem no higher than twelve inches. The plants were expected to revert to the vegetative cycle and could then be reflowered. Eighteen days after refilling the garden with clones and regenerates, the lighting cycle was cut back to the flowering cycle of 12 on and 12 off. The second crop was starting to flower.

Just before she cut the plants back Liz trimmed off some of the lower branches. This gave her plenty of clones of her favorite plants. She placed the cuttings in her floating clone chamber. After three weeks they were transferred to the stage-two garden and planted into 6-inch containers. Since then cuttings have been taken off these plants and placed in the cutting chamber. For the first time all three of Liz's gardens are being used. The rooting section, the

stage two vegetative growth section and the flowering section all have healthy plants ready to grow up or grow ripe. **Liz was a good caretaker. The plants were growing quickly, looked vigorous and showed no signs of deficiencies.**

During the Christmas season Liz discovered “water fountains” which were sold as automatic Christmas tree watering units. They maintain a water level by automatically distributing water when the level sinks. The reservoirs are designed to keep the water level at two inches. The water is stored in a 2-liter (approximately 2 quarts) plastic soda bottle and travels through a small tube directly into the tray. The water level can be adjusted by raising the water fountain unit.

Liz proved that you don’t need an expensive growing system to produce high quality marijuana.

She designed the system, renovated the closet and grew the first crop from seed in about 100 days. Her second crop, from hardened clones and regenerates, took about 85 days.

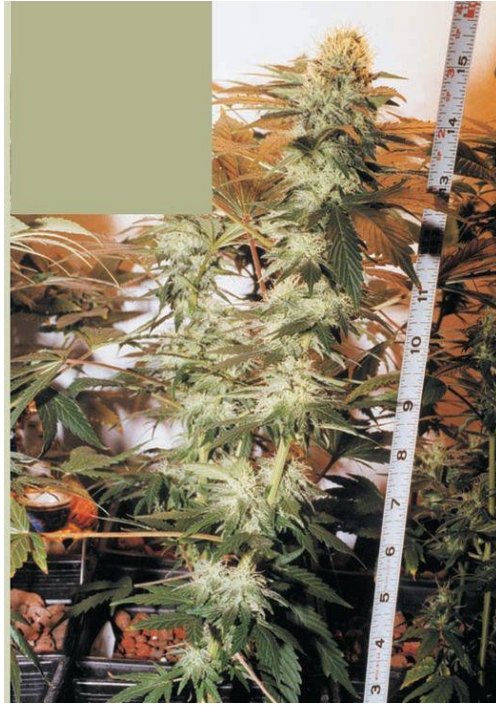
After two more crops Liz changed over to a 1000-watt lamp. This increased production linearly from seven ounces to about 16 ounces of prime bud per crop. Heat build-up was the only problem she had with using the additional power. She solved this by using a more powerful fan.

There are several things Liz could have done to fine-tune her garden, which was already very successful. The first is to have changed the CO2 regulator to a unit that measures CO2 concentration continually and automatically maintains the desired CO2 level. With this unit, CO2 levels would have been maintained more accurately, resulting in more growth.

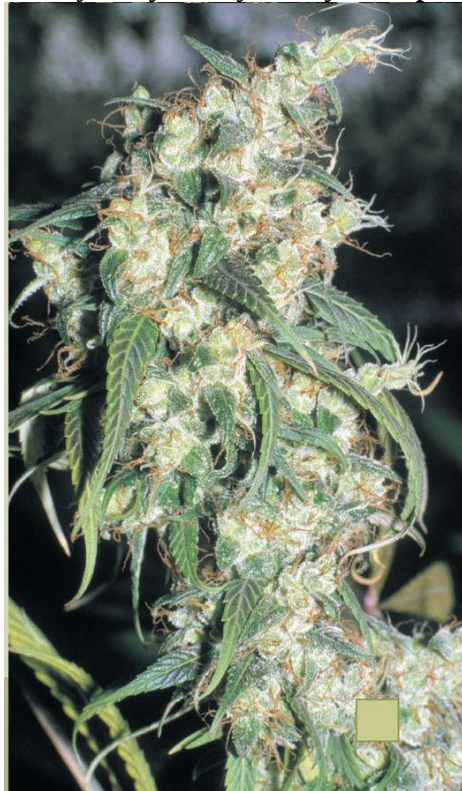
She could have installed an air-cooled reflector for the 400-watt and especially for the 1000-watt high pressure sodium lamp. The reflectors have a glass plate at the bottom of the reflector. Air from outside the space is drawn through a tube by a fan and is pushed past the bulb, where it is heated. A tube on the other side of the reflector draws the air out where it is released outside the space. The air in the room never gets heated, so it does not need as much ventilation.

Luckily in the city where Liz lived, the fertilizer and water pH combination achieved a perfect pH range for the plants, between 6.1 and 6.5, slightly acidic. In this range the nutrients stay in solution and are available to the plants. Outside this range, the nutrients precipitate and are unavailable to the plants. It is easy to measure using a pH meter or pH test strips. To adjust the pH, use pH Up or pH Down, found in indoor garden shops.

This indica plant was only 13 inches tall. The plant will mature in about two weeks but its vertical growth has stopped. Instead, all its energy goes into flowering.



A sativa- indica hybrid just days away from perfect ripeness.



The Port-A-Closet



I recently met a grower who had a unique and innovative method of cultivating. Poor Starving Graduate Student (PSGS), as he wishes to be known, needed a discreet and unobtrusive system, but he had very little space in which to work. To make matters more difficult, he would have to relocate three times during the year to complete his post-graduate research. Using an armoire, PSGS designed his “Port-A-Closet” to utilize his space most efficiently. Materials

PSGS, as his name implies, was a poor starving student supported by meager scholarships and summer jobs; his current recreational experience with ganja having been limited to gifts and joint circles. There was only one solution: to grow his own.

PSGS hunted and gathered his supplies on the streets and in the many thrift shops in his college town. He visited three shops, bought four shirts and some blue tinted drinking glasses before he found a metal closet that fit the space. It was 38” x 28” x 6’. After sanding away the rust spots, he spray-painted it a color matching the room in which it would be placed. It was a handsome addition and fit in perfectly with the rest of the décor. He also purchased 25 pounds of aquarium gravel, ten 1 1/2- gallon plastic plant containers (each measuring about 8 inches across at the top) and 25 three-inch containers.

The first part of recycling is re-using. PSGS noticed discarded wood while bicycling home from campus: 1” x 3”s, 2” x 4”s and 4” x 4”s that had already been cut to convenient carry-home sizes. He also picked up a torn reflective “space blanket” and a heavy-duty plastic tarp that people had left on the street.

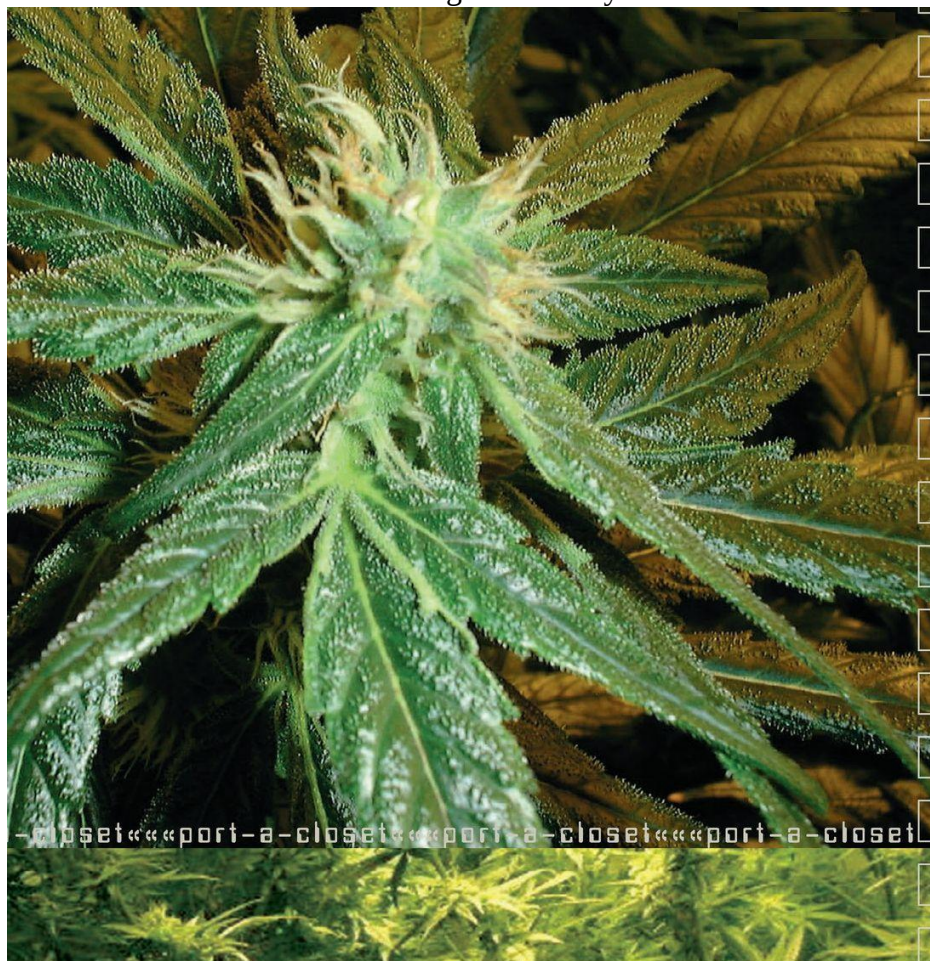
At the hardware store, he bought eight ceramic incandescent sockets, two 6-plug power bars (with circuit breakers), a heavy-duty extension cord, a 24-hour timer and a few 14- x 9-inch plastic houseware trays.

While gathering the materials to build the system, PSGS was constantly on the lookout for abandoned potted plants. Most of these were poinsettias tossed after the season. Different pots contained different mixes; mostly wood bark and compost, vermiculite, perlite, peat moss and coconut hull. The various grow media were shaken from the roots of the discarded plants into a large box. Last to be added to the mix was a discarded bag of unused foam rubber bits. The biggest expense was the 250-watt HPS system. He purchased a used system advertised in the weekly paper for \$125. The ballast was equipped with a timer and the seller gave PSGS three half-used gallon containers of hydroponic fertilizer consisting of grow and bloom fertilizers and a micro mix.

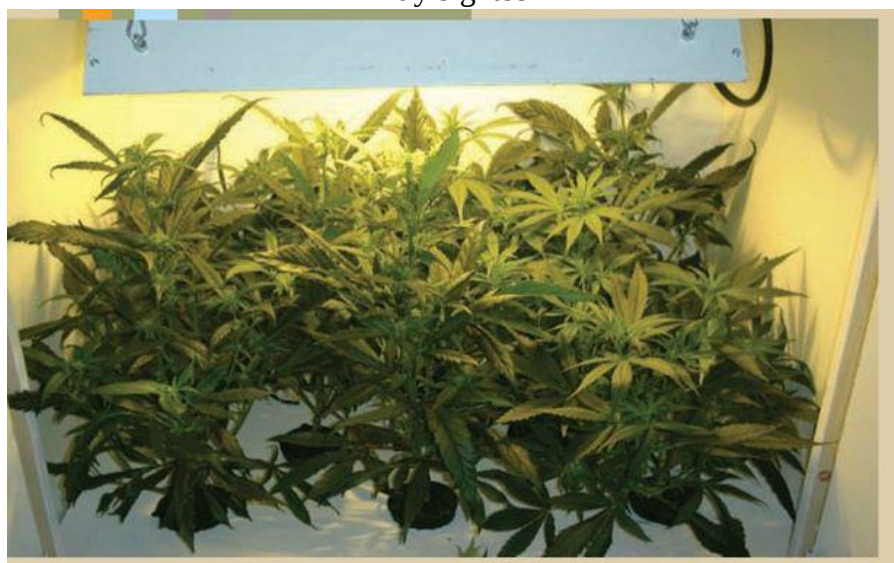
Photos courtesy of Brian McAndrew, Beyond Graphix, www.openminder.com



A closet-grown beauty.



Day eighteen



Construction

The inner walls of the cabinet were lined with the 6' x 5' space blanket. Areas not covered by the blanket were spray-painted white. The 250-watt HPS lamp was hung from the built-in hanger bar using several pieces of nylon cord. Then the side lighting, four 8-inch circular tube fluorescent fixtures, was installed. Each light was screwed into a ceramic light bulb socket and hung from either end of the hanger bar. The other two were hung along the back wall using eyehooks screwed into the top of the cabinet. To do this, PSGS drilled two holes through the top of the unit and pushed eyehooks through the holes.

Using a hacksaw and a pair of metal shears, he cut a six-inch hole in the top of the closet, and installed a six-inch velocity fan on top to remove the hot air. Placing a piece of foam rubber between the fan and the metal cabinet eliminated vibration noises from the fan. To allow fresh air into the grow space, a four-inch hole was cut in the lower back of the closet.

The lights and fan were plugged into the two six-outlet power bars with circuit breakers. These, in turn, were plugged into the heavy-duty extension cord that ran into an outlet near the closet. **PSGS hunted and gathered his supplies on the streets and in the many thrift shops in his college town. He visited three shops, bought four shirts and some blue tinted drinking glasses before he found a metal closet that fit the space.**



The bottom of the closet was lined with two layers of the heavy plastic tarp attached to the sides of the closet with duct tape to help prevent spills. Implementation

PSGS mixed his potluck medium thoroughly, adding 25 pounds of aquarium gravel. The result was heavy medium. When he added water/nutrient solution, the medium felt very porous, moist, almost wet, but nonetheless airy. He then poured the medium into the small containers.

PSGS had been planning to grow for about six months and had been

saving seeds. A few were found in some stash sinsemilla and some were collected from friends. All were domestic.

The seeds were planted in the four-inch square containers, about 1/4-inch deep. The pots were placed in trays under the HPS lamp, but the fluorescents were left unplugged. The containers were watered with the hydroponic grow and micro solution, diluted to half of the strength recommended on the label. To keep the seeds moist, plastic wrap was laid across the tops of the containers. All the seed germinated within a week.

About two weeks after germination, when the plants were about eight inches tall, the lights were turned down to 12 hours per day.

All the plants began to flower within 10-15 days. The males were pulled, leaving 16 pots with females. Only eight females were needed. Five of the plants looked less vigorous than the rest and were pulled immediately. The eight best were planted in the large containers set up with wicks and the light was then put on continuous illumination.

When the plants were between ten and fifteen inches tall – about 5 weeks after germination – the bottom layer of fluorescents was turned on so that the plants received light from the side as well as from above. At the same time, the tops of the plants were cut to even out length and to encourage branching. About a week later when the tops were between 18 inches and 24 inches tall, the light cycle was reduced to 12 hours per day to induce flowering. The Wick System

PSGS wanted to try the wick system of irrigation. He began by cutting the 4" x 4" wooden beams into blocks. He placed them under the containers to raise them above the trays serving as reservoirs. For the wick, he cut eight pieces of 3/8-inch nylon cord, long enough to run across the bottom and out both sides of each container to the tray's base.

To get the wick system going, PSGS simply filled the trays with water/nutrient solution. However, he enjoyed hand watering so much that he watered from the top regularly to supplement the

wicks. Finishing Touches

When the plants started to flower, they turned quite odoriferous. PSGS solved the problem with a negative-ion generator, which he purchased at a thrift shop for \$15. He placed the unit on top of the closet and it zapped the odors as they blew out of the fan hole.

PSGS harvested the plants over a 15-day period beginning 70 days after forcing flowering. His yield was about six ounces of very high quality bud. Soon after his post-graduate research was complete, PSGS temporarily shut down his “Port-A-Closet,” packed it up along with his other furniture and set off for a new location.

A personal grow unit



Equipment Costs

Metal closet:.....	\$25
Spray paint:.....	\$3
Aquarium gravel, 25 lbs.:.....	\$3
1 1/2-gallon containers (8):.....	\$3
4-inch pots (25):.....	\$3
Incandescent sockets (8):.....	\$16
250-watt HPS unit:.....	\$125
Screw-in fluorescents (8):.....	\$70
Circuit breaker with extension cords (2):.....	\$17
Heavy-duty extension cord:.....	\$7
24-hour timer:.....	\$8
Negative-ion generator:.....	\$15
Plastic houseware trays:.....	\$17
Drop cloth:.....	Free
Planting medium:.....	Free
Space blanket:.....	Free
 SUBTOTAL:.....	 \$312
 Electricity (852 kilowatts) @ \$.12:.....	 \$102
 TOTAL:.....	 \$414

Gassing 4 Growth



The CO₂ sensor continually monitors the amount of CO₂ in the air.



Carbon dioxide is a gas that makes up about .035% or 350 parts per million (ppm) of the air. It is odorless, colorless, non-combustible and not dangerous to breathe. The introduction of CO₂ to your garden is a cheap and easy way to increase its yield because it is an essential ingredient used in photosynthesis. High levels of CO₂ increase plants' efficiency in using light to fuel the process. In fact, as the amount of CO₂ in the air increases so does the rate of photosynthesis, as long as there is adequate light. Since CO₂ is cheaper to supply than electrical light, enriching the air with CO₂ is the most inexpensive way to increase production. Before installing a second light, the best investment in the garden is a CO₂ system. Once the system is installed it costs little to operate and offers a big payback.

Almost all forms of life depend on photosynthesis – a process in which green plants combine CO₂ with water to create sugar and free oxygen. Plants mine the air for the CO₂, which they absorb through pore-like openings in their leaves, called stomata, while the roots pull water into the plant. Sugar is used by the plants to fuel metabolism, in much the same way animals use hydrocarbons for energy. The sugar is also combined with various elements and minerals to create amino acids and to build tissue. Creating sugar requires energy. This is where the sun or the high pressure sodium (HPS) lamps come in. Plants use light to fuel photosynthesis, and the energy from the red and blue spectrums triggers a cascade down the biochemical highway with sugar as the end product.

Four factors are required for photosynthesis: water, CO₂, light (the source of energy), and minerals or nutrients required for the plant's life processes. A fifth factor, suitable temperature, is necessary for optimum plant growth. In an indoor garden, delivering enough water and nutrients is not generally a problem, and proper temperature can be maintained using air-cooled lights, ventilation and air conditioning – this leaves light and CO₂. Of course no electric light source can replicate the intensity of sunlight on a clear summer day. However, gardens using 50 watts or more per square foot under HPS lamps receive enough light to produce good harvests of high quality bud. As for CO₂, in a closed space filled with marijuana plants, at the end of the dark period, the air is high in CO₂ resulting from plant metabolism. However, when the light turns on, the plants start to photosynthesize and quickly use up the surplus of CO₂, lowering the level to 200 ppm. At this point the plants have a difficult time pulling more CO₂ from the air. Photosynthesis and plant growth virtually stop. The plants cannot continue the process until more CO₂ is provided.

Adequate amounts of CO₂ are easily maintained in well-ventilated areas. In Holland, where grow rooms are continuously cooled using powerful fans evacuating heated air, CO₂ is rarely used. Adequate CO₂ levels are maintained through the fast exchange of air. However, enriching the air to 1,000-2,000 ppm of CO₂ can increase plant productivity in a linear ratio up to 300%. Most growers see a production increase of 20-30%, along with a slightly shorter time to maturation. The optimal amount of CO₂ the garden can use depends on the intensity of the light it receives. Gardens using 50-60 watts input of light per square foot benefit from CO₂ enrichment to a level of 1500-2000 ppm. Marijuana uses CO₂ only when the light is on. There is no need to enrich the room when the lights are off. The gas can be used during both vegetative and flowering cycles. There are several ways to add CO₂ to the garden. These include combining baking soda and vinegar, which react to produce CO₂; fermenting sugar with yeast; the evaporation of dry ice to CO₂ gas; and using CO₂ generators that burn propane or natural gas. However, the most practical system for a small garden is using a tank of compressed CO₂.

The tanks, which come in 20- and 50-pound sizes, can be bought or rented from grow stores and companies listed under "compressed gas." A 50-pound tank, when filled, weighs 170 pounds. For small gardens, the 20-pound tanks are much more convenient, weighing only 50 pounds when

filled. The tank should be placed in a space where it can be replaced easily and the CO₂ gas line can be run to the garden.

To control the emission of the gas, a combination pressure-regulator /flow-meter controls the pressure at which the gas flows and the amount emitted per minute. The flow meters appropriate for small gardens emit 10-15 cubic feet per hour. A solenoid valve turns the flow on or off. Several kinds regulators can be used to control the solenoid valve. Some are on timers, while others are ventilation-based. The easiest regulator to use is an on-line meter. You set the desired ppm, and the regulator does the rest as it constantly measures the amount of CO₂ in the air. It requires no calculations on your part and is the most accurate method of delivering CO₂ to the garden. **Kits for brewing beer are a convenient way to make homebrew while enriching your homegrown with CO₂.**

With all regulators except the on-line meter, you have to calculate the volume of your grow room so that the proper amount of gas is released. To do this, multiply the dimensions of the grow space (length x width x height). The result is the cubic area of the space; for example, a room that measures 9' x 12' x 11' has an area of 1,188 cu.ft. To find the amount of gas required to enrich the garden to 1,000 ppm CO₂, multiply the volume by .001. An area of 1,188 cu.ft. would need 1.18 cu.ft. of CO₂. To enrich to 1,500 ppm, multiply the volume by .0015; for 2,000 ppm, multiply by .002.

Inexpensive electronic short-range timers can be programmed for up to eight events per day. These should be programmed for the maximum number of events, starting at lights on, with the last one an hour or two before lights off. Grow stores offer more sophisticated units that coordinate a timer with the ventilation system and can be programmed to inject the gas every twenty minutes so the plants are constantly bathed in CO₂. The best way to enrich the garden on a timer system if there is infrequent ventilation is by rapid injection of air. If the ventilation fan is on at all times, blowing CO₂ out of the garden, a small stream of CO₂ can be constantly emitted.

To find out how long the valve should stay open, divide the volume of gas required by your meter's flow rate. For 1.2 cu.ft. of CO₂ at a flow rate of 50 cu.ft. per hour, you would need to leave it open for .024 hours. Now multiply .024 by the number of seconds in an hour (3,600) and the resulting figure is 86 seconds, almost a minute and a half. If there is frequent ventilation in the room, spread out the time of enrichment by lowering the flow rate. If the flow valve were

adjusted to 10 cu.ft. per hour, it would take slightly more than 7 minutes.

Once the gas moves through the valve, it should travel by tube to the garden area, where it is released from laser tubing hung over the canopy of the plants. Available at garden shops, laser tubing has holes perforated every 8 inches and is used for drip irrigation. CO₂ from the tank is cooler and heavier than air, so it sinks down to the tops of the plants. With good ventilation the gas will mix throughout the canopy. Other Sources of CO₂

Some cultivators would like to use CO₂ in their gardens but are wary of hauling CO₂ gas tanks into their homes. There are several options including dry ice, horticultural CO₂ generators and water heaters, the fermentation process, and various other chemical processes, like combining vinegar and baking soda. Dry Ice

Dry ice is 100% CO₂ which has been cooled to -190°F. At that temperature, the gas condenses directly into a solid, skipping the liquid state. It looks like ice with a vapor around it. As the block evaporates it enriches the air with CO₂. It is so cold that it is dangerous to touch with your bare hands and should only be handled with appropriate gloves. The problem with using dry ice is that its evaporation can't be controlled well. It continues to evaporate whether it is needed or not. When the block is larger, more evaporates; as it shrinks it releases less gas. Smaller pieces, which have a higher percentage of surface area, evaporate more quickly than larger pieces. Keeping the ice in a freezer or in a Styrofoam chest will slow the evaporation rate. It may be feasible and convenient to use dry ice if you have an inexpensive source. The gas could be collected as it evaporates during the dark period and then released during the light. Imagine a block in a sealed Styrofoam container. A tube from the container fills a tightly sealed plastic bag during the dark period and the gas is manually released into the

garden during the light period. One pound of dry ice releases 8.7 cubic feet of gas. CO2 Generators and Water Heaters

Horticultural CO2 generators burn natural gas or propane, creating heat and CO2. They can be installed directly to a natural gas line or propane tank. Most models have a pilot light. They are best regulated using an on-line CO2 meter and regulator, which opens and closes the gas line as needed. Systems can also be regulated using a repeater timer. Once a generator is installed, it operates trouble-free automatically and provides a very inexpensive source of CO2.

The CO2 sensor relays this information to a regulator (pictured), which can be used to control a CO2 tank or generator.



The two drawbacks to using a natural gas CO2 generator for most home gardeners are that the installation of a natural gas line to the grow space could be costly and that burning natural gas creates heat that must be removed from the garden. The heater's generators can be adjusted to run on propane, but then the pilot must be relit each

time the tank is replaced.

There are household sources of CO₂ which may be feasible to incorporate into the grow space. Water heaters burn natural gas and release CO₂, so placing the heater in the grow space will provide bursts of CO₂ each time hot water is used, at no additional cost.

Care to cook in your garden? Gas stoves burn natural gas and release CO₂ and water vapor. A cooked meal could mean extra CO₂ for your plants. That's why plants often thrive in a well-used kitchen. Natural gas powered lamps release CO₂ and a high-quality light that is high in the red spectrum, which is used to fuel photosynthesis. A mantle burning all day would brighten the garden and provide the plants with CO₂. Biological Fermentation

Yeast is a single-celled organism that "eats" sugars and releases alcohol and CO₂. For every pound of sugar used, .488 pounds or 7.8 ounces of CO₂ and .513 pounds or 8.2 ounces of alcohol are released. Fermentation takes about 3 days at 70°F-80°F and up to ten days at 55°F.

One pound of CO₂ is equal to 8.7 cubic feet of gas. Thus, a pound of sugar produces about 4.25 cubic feet of gas. To produce one pound of gas, 2.05 pounds of sugar are required. A 50-pound gas refill costs about 20 to 40 cents per pound. At 25 cents per pound of sugar, a pound of bio-CO₂ costs 51 cents. Of course, there are two byproducts: 16.75 ounces of ethyl alcohol per pound of CO₂ produced and a residue high in raw brewer's yeast.

Each pound of sugar in one gallon of water creates about 6 percent alcohol. Once the alcohol content of the water gets up to between 9 percent and 12 percent, the yeast becomes inactive. Only when the alcohol content of the solution goes down will it start metabolizing the sugar again. This means the ideal solution is 1.5 pounds of sugar per gallon of water, which will produce 9 percent or 18 proof alcohol.

A five-gallon bucket, using 7.5 pounds of sugar produces almost 19 cubic feet of gas over a three-day period, or .26 cu.ft. per hour. This

**is enough gas to keep a sealed, 250-cubic foot space (5' x 5' x 10')
enriched with CO₂ at 1000 ppm. Set-Up**

To set up a bio-CO₂ unit, you will require a container of sufficient size with a tight-fitting lid. Wide brim five-gallon food containers are convenient. Fifteen or 30 gallon containers can also be used, but remember they are hard to move once filled.

A rubber or natural cork should be fitted to the container, with a plastic tube attached so that the CO₂ can be released or saved once it is produced. Either a commercial airlock or homemade one must be used in order to prevent the solution from getting contaminated with airborne wild yeast. You will also need a cooking thermometer measure the water temperature. Ingredients

A five-gallon jug uses about 7.5 pounds of sugar, boiling water, champagne yeast, and yeast nutrient. These are available from wine and beer making supply houses.

The alcohol produced is ethyl (drinking) alcohol; the brew will taste pretty bad but the alcohol can be distilled. Good tasting brews can be made using malts and corn sugar but these take a little more effort. Kits for brewing beer are a convenient way to make homebrew while enriching your homegrown with CO₂. How to Do It

Thoroughly wash the containers and then rinse with a sterilizing agent made from one pint of hydrogen peroxide mixed in a gallon of water. Rinse again thoroughly with just plain water. Add the sugar and yeast nutrient to the container. Pour boiling water into the container until it is nearly full. Stir until the sugar dissolves, then cover.

When the temperature drops to about 90°F, add the yeast and set the airlock in place. You do not have to use a whole package of yeast to start a brew. Even the tiniest pinch is enough, since each pinch contains thousands of yeast cells. But the more yeast, the more vigorous brewing becomes. Within hours you will see the bubbles flowing. That is the CO₂. When the bubbling stops, the yeast has finished its feast.

The regulator controls a CO₂ tank with pressure valve, flow meter and solenoid switch.



A CO₂ generator burns propane or natural gas. The pilot light maintains the flame. When the regulator turns it on, the gas is burned, releasing CO₂, water vapor and heat. Because it releases both heat and CO₂, it is inconvenient for many grow rooms.



An atmospheric controller turns on coolers and dehumidifiers as needed. This model also shuts off the CO₂ when the ventilator is on.



The reservoir system is very easy to set up. This 1 square-foot tray holds nine 6-inch square containers filled with pea-sized lava. The lava draws the water as needed. Water is added to the reservoir every three days to maintain a 2 -inch water level. The water is changed every two to three weeks.



No Sweat Hydro



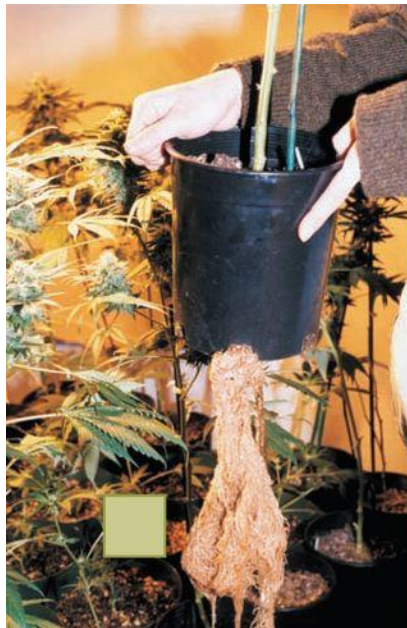
This wick system was constructed using a five-foot diameter kiddie pool, a shipping pallet and three gallon containers.



The planting mix in the containers drew water up the 3/8-inch nylon wicks. They maintained a constantly moist environment on which the plants thrived.



Some of the roots followed the wick down to the pool where they had unlimited access to the water/nutrient solution.



Most people don't realize that they have been growing plants hydroponically for years. When a plant is placed in a container, it starts to grow using water, CO₂ and various nutrients that the roots absorb. After a while the nutrients in the soil are depleted, plant growth slows, and the plant may show deficiency symptoms. Then fertilizer is added to the water and the plant starts to thrive again; it is being fed hydroponically. The soil acts as a non-nutritive medium that holds both water and the nutrients dissolved in the liquid.

The only difference between formal hydroponics and soil in the

container is that the hydroponic medium starts off with no nutrients while the soil's nutrients are mostly used up by the growing plant. Hydroponics can be as easy as soil to set up and maintain. Although you have probably read material that tells you how hard it is to grow hydroponically, you will find that it is actually a very convenient way to grow plants. THE SET-UP

There are many ways to set up hydroponic systems. Four are covered here; the wick and reservoir systems, which are two low-tech passive methods; and the ebb-and-flow and recirculating drip systems, which are the other two most popular hydroponic methods used by indoor gardeners. PASSIVE SYSTEMS

Passive systems use capillary action to draw water from a reservoir to the planting medium as moisture is depleted. Just as water travels up the fibers of a tissue, water will travel up many planting media. The system self-regulates and requires little maintenance besides keeping water in the reservoir. The Wick System

The wick system consists of containers filled with appropriate planting medium and braided 3/8-inch nylon rope that acts as a wick. Once the rope is moistened, it wicks up the water/nutrient solution so that water is either replaced as the plant uses it or lost to evaporation. As long as the reservoir below contains water the wick continues to draw it up as needed. Equipment required for the Wick system:

1. Heavy duty rubber gloves: These protect you from harm when you are washing or rinsing containers, working with planting medium, or preparing fertilizer solution.
2. Tray: The heavy-duty plastic tray – to act as the reservoir – should be at least six inches deep. They are available at indoor garden shops or hardware/houseware stores.
3. Containers: Standard plastic plant containers with holes on the side are all you need. Six- or eight-inch diameter pots are the most convenient. If you plan to grow larger plants, you can use ten-inch diameter containers. Pots are available at garden shops, nurseries or flea markets. Used containers should be washed and then rinsed in a solution of one quart 3% hydrogen peroxide in a gallon of water.

4. Wick: 3/8-inch braided nylon rope is available at hardware/houseware stores.
5. Container support: The containers are to be raised above the tray. Wire shelving, blocks of wood, Styrofoam blocks, or plastic or wood pallets are just a few ways to keep the containers above water.
6. Planting medium: There are quite a few kinds; you should test your particular choice before setting up. A mixture of coarse vermiculite and coarse perlite, available at indoor garden shops, is an ideal medium. Horticultural clay pellets, mixed 5-1 with vermiculite work well, as do most peat moss-based planting media.

Drip system using four-inch cubes placed on rockwool slabs.



7. Fertilizer: Use a hydroponic fertilizer as recommended on the package. Choose a brand that is popular in your area. Most fertilizers use different formulas depending on the plant's stage of growth, so use the proper formula for the stage of growth.

8. Pump: A small submersible pump is used to circulate the water/nutrient solution in the reservoir or an air pump with a foot-long aerator can be used to keep the water oxygenated and fresh. Setting Up

1. Place two wicks in each container. One end should hang out of each of the four holes. The ends should be long enough to reach the bottom of the reservoir when the containers are in place.
2. Fill the containers two-thirds full with the planting medium.
3. Place the seedlings or transplants in containers and fill the container to one inch below the top.
4. Place the container supports in the tray and put containers in place.
5. Mix the water/nutrient solution according to directions on the label.
6. Water the containers until it starts to flow out of the bottom holes.
7. Fill the reservoir with water/nutrient solution.
8. Place the pump in the tray to circulate the water.

The frame for the tray is made with two-by-fours. The 30-gallon reservoir services two 3' x 3' trays.



Care

Make sure not to let the reservoir run out of water. Always refill with water/nutrient solution. Change the solution every three weeks and feed your house or garden plants with the old solution – they'll love it. When you force the plants to flower, change the solution formula to "flowering" from "growth" stage. The Reservoir System

The reservoir system eliminates the rope and container elevators. The six-inch wide, eight-inch tall containers are placed directly in the tray. Water is added to a depth of 2 1/2 inches. Twelve-inch diameter containers are submerged about three inches. When the water in the tray falls to one inch, the tray is refilled. The reservoir system is best used with horticultural clay pellets or lava as the medium. These soak up the moisture but provide large air spaces for the roots to obtain oxygen. The other planting mixes get too soggy under partially submerged conditions.

Another, slightly cheaper, medium you might consider is red lava; it is often used in west coast gardens. The lava exhibits very good capillary action and roots thrive on the rough, jagged surfaces. The three main problems with lava are that it is considerably heavier than the clay pellets, roots stick to it, and it doesn't pour easily. The horticultural clay balls are less troublesome because they are much lighter, roots can be rinsed away easily, and they pour into containers conveniently.

The water in the tray should be heated to 72°F, the ideal

temperature for roots. A submersible aquarium heater with built-in thermostat will keep the water at precisely the right temperature.

ACTIVE SYSTEMS

Ebb and Flow

Ebb-and-flow systems, sometimes called flood-and-drain, work by periodically flooding the medium and then draining it. The numerous advantages include easy set-up, low likelihood of breakdown, and easy repair. Marijuana plants respond very well to this system of irrigation. Constant drip system using horticultural clay pellets. The continuous flow of water and the large air spaces create an ideal environment for the roots. In this system each container is watered using two emitters. Should one emitter clog, the other will still provide moisture to the container.



The tray is easily positioned in the frame and is held by the lips. This ebb-and-flow system has only two tubes. The small blue diffuser breaks the water up as it flows into the tray when the pump is activated, three times daily. The larger, gray PVC pipe is the overflow valve that drains back into the reservoir. When the pump shuts off, water in the tray drains from a hole in the tubing, which enables the water to drain back into the reservoir.



Equipment required for the Ebb-and-Flow system:

1. Tray mounted on a frame or table: Horticultural trays 2' x 4', 4' x 4', and 4' x 8', available at indoor grow shops, are the most convenient. However, trays can be purchased at houseware stores or made from wood coated with plastic resin or 30mm pond liner. The tray should be fitted with a drainage tube at the lowest part.
2. Reservoir: The reservoir should hold a minimum of two gallons of water for every square foot of tray space. For instance, a 4' x 4' tray (16 square feet) uses a 30-gallon reservoir. The plastic reservoir should be heavy-duty so that it can remain filled for extended periods of time without developing material fatigue. Indoor garden centers sell shallow, wide reservoirs that fit under ebb-and-flow tables. Heavy-duty trashcans may also be used but they are tall and need additional plumbing. For the most part they are not recommended.
3. Submersible pump with filter: These are available at indoor garden shops, houseware stores and pet shops. The price difference between a small pump and a larger one is only a few dollars, so buy the larger pump – it will be less taxed by its daily chores. **The numerous advantages include easy set-up, low likelihood of breakdown, and easy repair. Marijuana plants respond very well to this system of irrigation.**
4. *Small submersible pump or air pump: The small pump circulates water in the reservoir while air pumps release a wall of bubbles into the reservoir causing the water to circulate and pick up oxygen. The contact between the water and the air removes carbon dioxide from the water and replaces it with oxygen.*
5. *Tubing and drainage fixtures: The tray will have two drainage holes. The first should drain the tray more slowly than the pump fills it. The second is the overflow valve. A hole in the tubing leading from the pump can be used instead of a drainage hole. Once the pump starts, water backflows through the tubing and out the hole.*
6. *Multiple-event timer: to regulate the pump.*
7. *Aquarium heater: to keep the temperature at 72°F.*
8. *Appropriate planting medium such as rockwool, horticultural clay pellets, lava or coir.* **Setting Up**

- 1. Place the reservoir under the tray.**
- 2. Place the pump in the reservoir after attaching the tube to it. Attach the other end of the tube to the fixture in the tray.**
- 3. Plug the pump into daily multiple-event timer. During the vegetative cycle the timer is set to go on every 6 hours. During flowering it is set to go on when the lights go on, four and eight hours into the light cycle.**
- 4. Plug in the circulating pump or air pump to oxygenate the reservoir water.**
- 5. Place the drainage fixtures in the tray and attach tubing underneath so that all the water drains into the reservoir.**
- 6. Place the rockwool in the tray. Large cubes (4-inch) can be used directly in the tray or rockwool slabs with smaller cubes can be used. The clay pellets can be placed directly in the tray, but it is more convenient to keep them in individual containers. If the holes in the containers leak pellets, use a piece of nylon netting or horticultural shade cloth to prevent loss.**
- 7. Fill the reservoir and turn all the systems on. The Drip System**

The drip system is a very popular method of irrigating hydroponic gardens. A pump recirculates water from a reservoir along tubing to individual emitters. Each plant has an emitter to allow individual watering. The amount of water delivered and the number of times a day the plants receive irrigation is determined by the temperature, the size of the plant, and the planting medium. Setting up a drip system is similar to setting up an ebb-and-flow except that the pump moves the water through a series of tubes, then through individual emitters to the plants. The plants are held in containers, slabs of coir or rockwool, and individual emitters are placed within two inches of the stem of each plant.

Almost any medium can be used. Planting mixes, vermiculite-perlite and small gravel are considered wet mixes. They retain more water and need to be irrigated less frequently than planting mediums such as rockwool, coir or clay pellets. Wet mediums are watered every day or two at first. Once the plants grow and start using more water, the number of irrigations is increased. The drier mediums, rockwool and coir, are irrigated three times a day. The horticultural clay pellets do well with a constant drip because of the large air spaces between the pellets. Even with a constant flow of water the roots are exposed to large amounts of oxygen.

Sharkey's Garden



The bottom leaves have been trimmed from the plants to provide more air circulation and lower the humidity. The stakes are proving to be too short, but the flowers are still upright.



Sharkey is a professional grower who likes to work alone. He tried growing with a partner but found the fellow to be unreliable, which drove him up a wall. Sharkey takes the business of growing very seriously. He doesn't smoke marijuana because he doesn't like the high and sometimes it gives him a headache. However, he takes pride in the bud that he grows. Sharkey has always been an achiever and he sets high standards for himself. He earned a degree in civil engineering but after working on a few projects for a big firm he decided instead to open a restaurant. The eatery was successful but it was driving him bananas so he sold it. He kicked back for a few years before deciding to start growing marijuana. Several factors drove him to it. First, it seemed very profitable. It was challenging because of the usual farmer's woes as well as the surreptitiousness of the act. I should mention that Sharkey decided to enter the business during the mid-eighties, at the height of the drug war. He felt it was interesting, challenging work that was well rewarded. **Sharkey decided to enter the business during the mid-eighties, at the height of the drug war. He felt it was interesting, challenging work that was well rewarded.**

Sharkey's first project was a partnership with a fellow who had been growing for a number of years. Although his gardens were successful, he explained to Sharkey that, for one reason or another, he needed an investor-partner for his next project. Sharkey later related that he should have known better than to hook up with this gentleman. "If he had been growing commercially for a few years, why didn't he have money for the next project?"

With the first crop Sharkey saw that he had made a big mistake. The plants were not properly cared for, there were beer cans in the grow room, and watering the plants was hit and miss. He heard a lot of "I forgot, sorry" and "it's not worth the trouble". Ultimately, his partner offered opinions and ideas about cultivation that Sharkey knew were wrong just from taking care of his yard and houseplants. Harvest was a disaster. Eventually, Sharkey dissolved his partnership because of irreconcilable differences. He told his partner that he was getting out of the business because breaking the law was making him paranoid. He took half the vegetative plants to "sell to a friend."

If he had sold the plants he would have delivered more than expected. The plants were infested with aphids and mites. They were suffering from water stress, uneven light distribution, lack of fresh air and CO₂, and were unpruned and unwieldy. Sharkey took clones from the plants, carefully cleaned them and treated them with pest killers. Then he threw the mothers away. His plan was to set up a large hydroponic grow in a different section of town.

He rented a large space in an industrial section and re-wired it to carry the large electrical load. Large ventilator fans were placed in the roof so that the entire volume of air in the space could be replaced in about ten minutes. It took several months to get the space ready so he moved the clean young plants elsewhere to grow into mother plants as he was working.

The clone daughters were about two months old and two feet tall when the space was ready and they were moved into their new permanent home. They immediately started to fill out and develop healthy green leaves. Sharkey germinated several Dutch varieties and took clones from his mother plants. Both groups were growing in four-inch cubes placed on corrugated plastic sheeting on a 2% incline (one inch every four feet). The plants were spaced two per square foot. Since he had not had time to install the irrigation system when the clones were ready to grow out, he watered by hand several times a day. Sharkey decided to use a sweat line, which oozes liquid along its length, hooked up to a reservoir-recirculating system.

As soon as the clones and seedlings were about six to eight inches tall (about a week for the clones and ten days for the seedlings), the lights were switched to flowering cycle. Sharkey liked to start work in the early afternoon so the lights turned on at noon and went off at midnight.

Thirty days had elapsed and what should have been an uneventful period of continued

construction turned out to be one of trouble and problems. Fate or carelessness took its course.

An unidentified tan-colored insect, about 1/16th of an inch long attacked the plants. The insect grazed along both the bottom and the tops of leaves, exposing plant tissue to infection. All of the leaves on all of the plants showed extensive damage including spots of tissue necrosis. The plants were flowering and had about three weeks to go, but the insects had zapped all their energy, so the buds were small and the yield was not expected to be very large.

To get rid of the critters, Sharkey sprayed them with a ready-made pyrethrum mix propelled through a high-pressure tank. Then he used a Holiday Fogger to knock out any survivors. His insect control strategy worked.

The Dutch seeds were germinated in 4-inch x 4-inch Gro-Dan rockwool cubes. Each of his four tables measured 8' x 12'. The 1152 plants on each table were still being temporarily watered by hand, as Sharkey continued working on installing the irrigation system.

Sharkey's first crop: He and his partner had just split up and Sharkey took his half of the plants to the new space. These were an unruly undomesticated variety. They were a sativa hybrid with heavy vegetative growth but small flowers. This variety was eventually discarded.



In order to fill up his grow space and get ready for his next crop, Sharkey decided to grow a major portion of his new crop from hybrid seed, which he had to generate. He used females from his known variety, which was small budded, low-yield and fairly potent, and Dutch descendant males for pollen. Northern Lights and Skunk #1 were placed in separate rooms with females for pollination.

Pollen was also collected for controlled crosses with Dutch females. To catch the pollen, Sharkey constructed a box holder and placed the male plants horizontally in it. That way, the pollen didn't have far to drop when the flowers opened. The purpose was to prevent pollen from getting in the air. More is collected and fewer uncontrolled pollinations occur. Meanwhile, the young plants growing from Dutch seed in the vegetative growth area were doing well. They were about 12 inches tall and almost ready to be transferred to the flowering space.

At the end of the second month Sharkey had encountered a few bumps. The infection had hurt the plants before it was eliminated and construction was taking longer than anticipated. However, the plants were in good shape. The completed construction was coming along well and soon the entire space would be automatically controlled.

A month passed and major changes took place in Sharkey's garden. The original variety

recovered from the insect attack after the pests had been eliminated. Fast growth resumed, but the plants developed loose, abundant buds. This indicated a lack of light intensity. Sharkey was using only four lights on his 12' x 8' tables. That's 96 square-feet, with a power input of about 40 watts per square foot. Requiring a more intense light, the varieties that he was growing would have done a lot better with 60 watts per square foot, an increase of fifty percent. Some of the Dutch varieties, which sat on the same tables, were doing better. They had been pollinated selectively and seeds were ripening on them. Although their buds were small because of the heavy seeding, they were compact, unlike the clones from the original mothers, which tended to stretch out a bit even after they were forced to flower.

More clones had been taken and were sitting in the clone room. They would be flowered, but first Sharkey planned to start a new generation from the seed he was breeding. He would let the plants indicate sex and take clones of the females for the next crop.

More than two months later, the watering system was finally completed and hand watering was no longer required. The plants were irrigated as often as six times a day during the last part of the vegetative growth cycle. By the time the system was installed they required water only twice a day.

The four-inch rockwool cubes sat on top of six-inch rockwool slabs. Black feeder hose emitters watered under the plastic, irrigating each cube. The water soaked down through the threefoot pads.

A CO₂ generator that burned natural gas was installed, but not without problems. The unit was near the ceiling and the CO₂, which is warmer than the air, stayed at the top of the space rather than at plant level. Sharkey lowered the unit close to the floor so it could blow the hot CO₂ gas down to the floor first. The cool floor acted as a heat sink, cooling the CO₂ so it would remain at plant level.

Even with all the work that had been done and the sophisticated irrigation unit, the leaves still indicated a nutrient irregularity. It looked something like a magnesium deficiency with veining or a low-grade iron/manganese deficiency, which would turn new growth yellow, but the necrosis and particularly dull color of the leaves indicated that it probably wasn't either of these. A calcium deficiency was another possibility. The plants lacked vigor and were not brightly colored. To eliminate the nutrient problem, Sharkey planned to rotate flowering fertilizers in his one-way system to assure a more balanced formula.

The first watering system Sharkey installed consisted of a soaker line the length of each slab of rockwool and sandwiched between the slabs and cubes. This system had not performed up to expectation. The blocks remained wet, but the nutrients seemed to be concentrating because of evaporation. He removed the soaker hose and installed a standard drip system. **To get rid of the critters, Sharkey sprayed them with a ready-made pyrethrum mix propelled through a high-pressure tank.**

In spite of all the difficulties, the cycle continued and soon the flowering room was filled with buds. Sharkey had two groups of Dutch plants. The first was grown for seed. Some of these plants had matured, but the rest of the batch was still ripening. The other group consisted of plants that Sharkey started out with. These were a mixed group, mostly sativas with a few hybrids and indicas. Some of the plants were six feet tall when stretched out but they were bent over and interfered with their neighbors, often blocking their light. The sativas were the least appealing, with long internodes and airy, loose buds.

Before forcing the plants he brought to his new garden, Sharkey took clones and used them for the second crop. The cuttings were rooted in rockwool sheets in 10-inch x 20-inch trays. The trays were kept on heat mats, which kept the cubes at 72°F.



Sharkey was working on this problem, too. He pruned the lower and side branches so that all that remained of each plant was a main cola and a few branches. The tallest, most gangly plants had the least bud development so he eliminated them from the garden. He thought that by removing extraneous material from the plants he could allow them to get better light and grow bigger buds as a result. The Dutch plants were pruned too.

Sharkey produced thousands and thousands of seeds from Dutch mothers in order to fill the space with high quality plants. The seeds were germinated in rockwool pellets pushed about a half-inch into the fiber. The rockwool germinating slabs were placed on small pallets so that they were not touching the heating mats underneath. In an effort to save a few dollars, Sharkey neglected to purchase a thermostat to regulate the mats. This dubious logic cost him three quarters of the seeds he planted. The temperature in the trays climbed to over 85°F, spelling doom for the seeds. The few trays that were not placed on the heating mats had a much better germination rate.

Sharkey decided to grow the cuttings in the flowering room. He gave them a weak water/nutrient solution supplemented with corn syrup at the rate of about a tablespoon per gallon. Corn syrup consists of plant sugars; since the cuttings were stressed, he figured the extra sugar, normally produced by the plant as a product of photosynthesis, would give the plants some vigor and might enhance their growth. This idea was abandoned after a brief trial. The syrup messed with the irrigation and it looked like it was starting to ferment.

He also hoped that the remaining side buds on the plants, small because of their position below the canopy, would fill out given better light. With the fan leaves trimmed and the top buds removed, they could be spaced closely so that the yield per square foot of space would be relatively high. Sharkey comments that growers sometimes become lackadaisical about things like trimming because it is so tedious. He is a one-man operation and wants no one else to be involved. If he could hire someone, as a legal business can, a trimmer could be had for \$5-\$10 an hour. Instead, he has to do the work himself. He says that sometimes he has half a mind to neglect trimming, but when he realized that those trimmings might represent a loss of a half-pound to a pound of trimmed, dry bud, it motivated him to buckle down to the hours of tedious work.

Two 10-inch x 20-inch clone trays were lit using two 48-inch cool white fluorescents. This table held two sets of clones. An older group was growing vegetation rapidly while the younger group in the back was busy growing roots. The trays were covered to keep the cuttings moist.



I visited the garden a month later. He was increasing the cultivation space while fine-tuning it for efficient operation and high yield. He had already harvested his Dutch seed crop, which yielded about 15,000 seeds of various varieties and crosses.

Most of the homegrown plant varieties, which were a mix of different sativas and indicas, had also been harvested. A month before, Sharkey had trimmed and thinned out the excess branches and all lower growth from these plants to promote growth. As a result, the light was more evenly distributed and the buds filled out a bit. Cutting the lower leaves allowed more air circulation so that there was less likelihood of mold problems. Potency varied from plant to plant but it was fairly high.

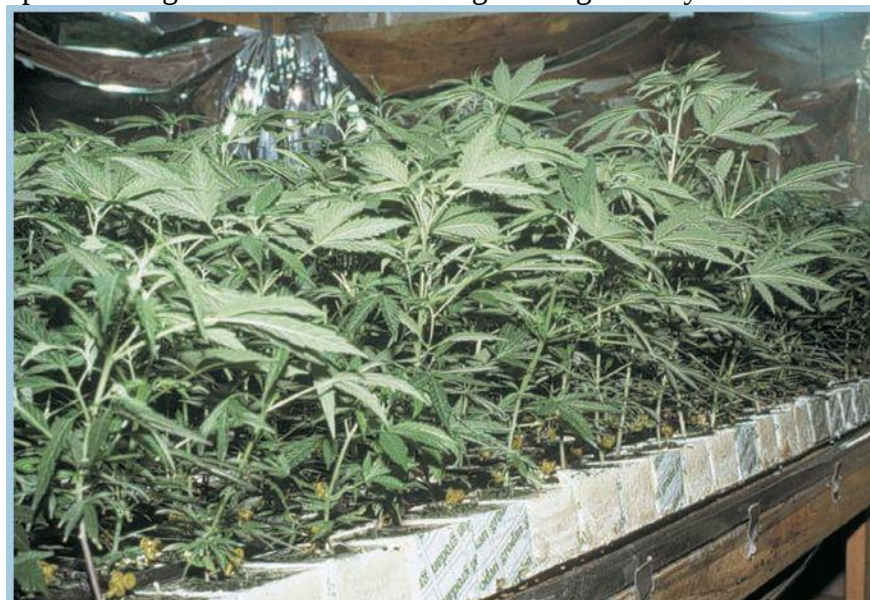
The plants yielded 10-14 grams per square foot. Here are the stats: the 96-sq.ft. table yielded about 1150 grams. There were four 1000-watt lamps. Each square foot had an electrical input of 41 watts. Each lamp yielded about 288 grams or .63 pounds. Considering that these were low-yield plants, this was hardly a disappointment. On the other hand, about 40 percent of the material was definitely grade B, lowering its value considerably.

The CO₂ unit had not worked out as planned. Lowering the unit to ground level sent drafts of hot air around the plants, warming them too much. The ground did not absorb the heat as Sharkey had thought it would. His new idea was to scuttle the generator and replace it with a gas air conditioner. The CO₂-laden exhaust from the air conditioner would be mixed with the cooled air and directed into the growing area at ground level.

Shortly after the clones were started, Sharkey started seeds from several Dutch varieties. They were watered using drip emitters. The cubes sat on a grill for easy water drainage. These seedlings were the start of the new population.



Plants in stage 2, vegetative growth. The clones in small cubes are placed in four-inch rockwool cubes that have an indentation to hold them. They are placed in a small section of the garden to harden the plants and give them some time to grow vegetatively under continuous light.



After two weeks of vigorous vegetative growing, the plants are moved to the flowering room. The cubes are placed on rockwool slabs wrapped in white plastic. Spaces are cut out of the plastic and the cubes are placed in position. The plants are given a couple of days under continuous light. Then the lights are cut back and the plants begin to flower.



The new crop in the flowering room would be ready in five to six weeks. These consisted of clones from the Dutch varieties. They were kept in vegetative state for a little extra time, then cut back in order to produce cuttings for rooting. There was also a crop that was almost ready to pick.

Soon the garden would be producing one crop per month.

Sharkey eventually discovered that his nutrient problem was a lack of calcium and a touch of magnesium. The necrotic spots and slight veining were the result of using a fertilizer formulated for hard water, which contains more of these substances in a dissolved state. The purer water he was using did not supply enough. Adding a calcium-magnesium fertilizer formula to the water/nutrient mix solved the problem.

He added two lights to each table so the garden received an electrical input of 6000 watts distributed over 96 feet, a total of 63 watts per square foot, rather than the 41 watts the plants received previously. CO₂ and temperature control became big problems for the garden during the hot summer months. First he had the roof painted white, rather than its natural gray color. This relieved some of the stress. Still, the ventilation air from outside was 90°F and higher. Sharkey invested in a commercial air conditioning unit that was able to maintain a cool 75°F even when the outside temperatures soared above 100°F. Rather than create heat he invested in a CO₂ regulation system that automatically kept the garden at 2000 ppm. The garden used about 10 tanks a month.

It took Sharkey more than a year to get all the details worked out. As each knot in the system was unraveled, the garden's productivity increased. The garden eventually yielded about 1 1/4 pounds per light every 65 days. He worked out this schedule: Clones were taken from plants just before they were forced to flower – these were trimmings and side branches – and cloned in small cubes.

They were transplanted into 4-inch cubes to grow for another two weeks at a spacing of nine plants per square foot. Two weeks later, a month after they were cut, the young plants were placed in the flower room at a spacing of two plants per square foot. They remained in vegetative state for two weeks and then were forced to flower. They were harvested at about nine weeks.



Twenty days after the lights are turned to 12 hours on/12 hours off, Sharkey's plants are beginning to flower. They are staked so that each plant gets light without interfering with its neighbor.



Almost ripe seeded bud. The tissue covering the seed is beginning to pull away, exposing the seed. Seeded buds are heavy with glands. However there isn't much weight to the smokeable material and many of the glands wind up on hands when the seeds are separated out.



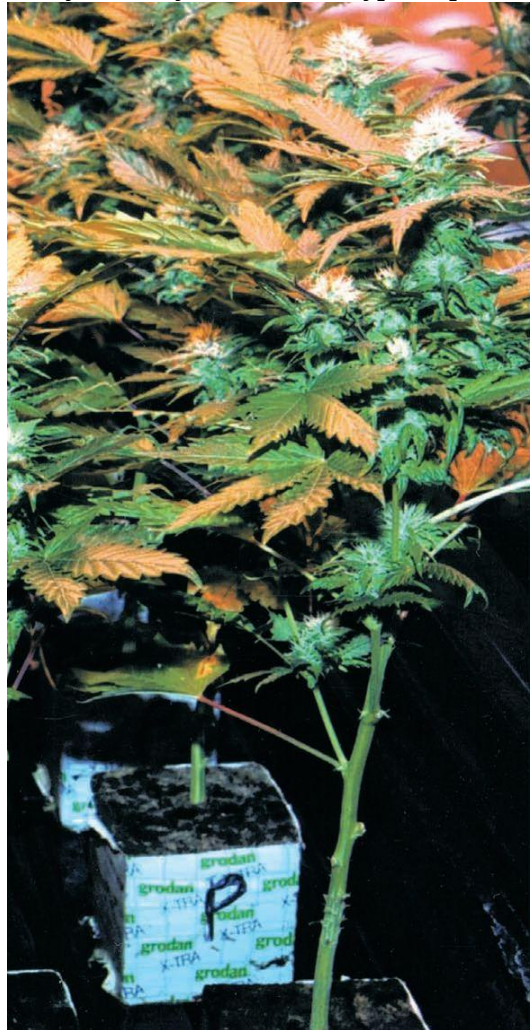
The manicured glands are placed on racks to dry and kept in a constant draft. They are dry and ready to be smoked in about a week.



Medical Success



Purple indicas have ended their vertical growth at about 13 inches. This popular variety produces heavy, chunky buds with a typical pure indica high.



California's Proposition 215, passed by voters in 1996, legalized cultivation of medical marijuana by patients and caregivers with a recommendation from a doctor. With no clear guidelines from the State Attorney General, interpretation of the law has been left to county law enforcement. In some places the police have taken to arresting growers and letting the courts settle it. This has backfired in a few counties, where juries have repeatedly hung or given a

resounding “not guilty”. Several areas stand out for truly enlightened and progressive policies. Oakland has a policy of 32 square feet indoors with a maximum of 72 plants; San Francisco has a flexible policy based on patients’ needs and tolerating caregivers; and Mendocino county voters approved a proposition allowing 25 plants for personal use. Unfortunately this proposition does not have the force of law because it contravenes existing state laws. However, the district attorney seems to be respecting its intent. In Sonoma County, where many people grow outdoors, medical patients are allowed up to 99 plants in 100 square feet.

Fortunately, Maya lives in Oakland. She and her boyfriend both use marijuana medically with a doctor’s prescription. Maya has chronic pain as a result of an automobile accident. Her boyfriend had adult onset insomnia, although he was only in his twenties. Their doctor at the health plan where they were enrolled empathized but refused to write a recommendation for marijuana. At a friend’s suggestion they saw another doctor, who looked at their medical records, gave them both relevant physicals, and wrote them the required notes. They took their notes to the Oakland Cannabis Buyers Cooperative, the organization functioning as agent of the City of Oakland for the issue of Medical Cannabis ID Cards to patients. They received their cards within minutes. They had been legal for about a year when the opportunity to grow arose. This is Maya’s story.

My boyfriend and I share a large live/work space with another couple. We had another housemate but he moved out to join the real world across the Bay. Under California’s Prop 215, the Medical Marijuana Initiative, and local Oakland regulations, each patient is allowed to grow in an area of 32 square feet and is allowed up to 72 plants. There is no limit on the number of lights. Since we are all patients with cards from the city-authorized Oakland Cannabis Buyers Co-op, it seemed like a good idea to get a garden started.

The doors to the room swing open revealing a highly productive medical garden.



I had been an outdoor guerilla gardener for many years but it was so much work that it hardly seemed worth the effort for the yield and I couldn't live in the city. Then there was the arduous task of packing in the material, the hassle of staying in the field as harvest approaches and the disappointment of small harvests. After my accident, I definitely couldn't make the effort required. Compared to the outdoor problems, the hydroponic set-up is so convenient and easy that you can grow soft and fat and lazy. The yields are higher and I like playing God with the plant.

A vote was taken and, instead of dealing with another roommate, we decided to make space available to another kingdom of life. We prepared to open our home to some babies available for adoption at one of the medical marijuana dispensaries. We read a few books and spoke with several indoor growers about their experiences. After a lot of research we chose the rockwool/ebb-and-flow system. Rockwool was readily available and disposable, and the system is easy to put together, maintain, and clean between crops.

A friend with construction experience helped build a wall, made frames for the trays, installed the CO2 unit, and began the electrical work, which still needs completion. The clones from the Dispensary were the best I have ever seen. They had strong roots, were ready to grow and were full of life. The strains we picked were AK-47 and Champagne, a total of 120 plants, well under the limit set by the Oakland guidelines.

We purchased the following equipment:

Three ballasts with lights (used):.....	\$800
CO2 online unit (including tank) which measures the air and regulates how much is injected into the room:.....	\$850
Dehumidifier (on sale):.....	\$200
Electrostatic precipitator:.....	\$35
Three squirrel fans:.....	\$120
Two oscillating fans:.....	\$60
General Hydro fertilizers:.....	\$70
Supplemental fertilizers (Cal-Mag and Protekt):..	\$40
pH meter:.....	\$120
PPM meter:.....	\$150
Submersible pumps:.....	\$65
Air-cooled reflectors and ducting:.....	\$360
Two reservoirs(30- and 75-gal.):.....	\$125
Electrical timers:.....	\$80
Total:.....	\$2,275

Growing your own pot... priceless.

When we started growing, the plants immediately began to show a magnesium deficiency. We decided to add Cal Mag after a friend told us that the Oakland water is too pure to use without supplements. Fertilizer formulas are configured to “average” water that has plenty of dissolved salts, including magnesium and calcium. Oakland water falls well below this average. We also added Protekt, a silicon supplement, to help strengthen the plants – researchers believe it gives plants resistance to stress. Within a week the plants returned to health. We had already purchased a pH meter to keep the plants at 6.3 pH – usually we have to add pH Down to the water. The two supplements had increased the amount of soluble salts to the water but we needed to figure out what was going on. This called for a ppm (parts per million) meter, which measures the amount of dissolved solids in the water. The meter showed that the supplements had raised the ppm to about 550 from 100 ppm. We decided to add half as much GH formula as we had initially. This brought the water-nutrient solution to about 1150 ppm. Because they can support the plant without watering for 24 hours, we decided on 4-inch cubes. We water three times a day; when the lights come on, in the middle of the cycle, and again just before the lights go off. Each tray is lit

using a 1000-watt HPS light in a horizontal air-cooled reflector. Intake and outtake fans keep the air moving so that the lights are well ventilated.

Two tables hold three 4' x 4' horticultural trays. The trays are set up as ebb-and-flow tables. The smaller reservoir serves a single tray and the larger one supplies the other two. Water is pumped from the reservoir for 10 minutes at a time. An overflow drain handles excess water pumped to the garden and the water drains slowly out of a smaller gap. The tray on the left holds Max 49s; the middle tray holds the shorter purple indicas in front and the taller AK-47s in the rear. The tray on the far right holds a mix of marked hybrids.



Under California's Prop 215, the Medical Marijuana Initiative, and local Oakland regulations, each patient is allowed to grow in an area of 32 square feet and is allowed up to 72 plants.

The control section: oscillating fans on either side of the room keep the air circulating.



Max 49, a sativa-indica backcross, tops out at 30 inches. It produces a very fat, potent bud with sativa qualities.



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This is our second crop in the room. Our first crop (AK-47 and Champagne) yielded 3 1/2 pounds. Champagne was the heavier producer and had very dense buds that weighed a lot but I preferred the AK-47, a moderate producer that has a very heady high. This time we are growing the Max 49, Northern Lights X Big Bud, White Widow and a purple indica. We anticipate a wide variety of medicine will be available to us with this crop.

I usually check the room twice a day to make sure the pumps and timers are working, and that the plants are happy. I check the temperature, humidity, CO2 and reservoir levels. I think a certain number of hours need to be spent staring at these amazing plants – it's sort of like being out in the garden, but indoors.

Marijuana Success Indoors
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